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The Farmer's Digest

From more than two hundred magazines and bulletins published in this country and abroad, the Editorial Staff of the Farmer's Digest selects articles of outstanding merit and general interest. It is comprehensive in its scope, covering all phases of Agriculture.

The Farmer's Digest

Published monthly at Ambler, Pennsylvania, by
The School of Horticulture

25c a Copy *$2.00 a Year*

Foreign Subscription $3.00 a Year

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Entered as second-class matter at the Post Office at Ambler, Pa., May 5, 1927, under act of March 3, 1879

The Farmer's Digest

Vol. 2 June, 1938 No. 2

Grass-Legume Silage

Condensed from Pennsylvania Farmer

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Dairy Dept., Penna. State College

EVIDENCE continues to pile up regarding the high nutritional value of fresh green grass or legumes harvested as silage by various methods. Some of the advantages that may be mentioned in favor of harvesting a part of the grass or legume crops as silage are as follows:

1. The carotene content of the crop is conserved to a considerably greater extent than when the crop is harvested as hay. Winter rations of livestock are likely to be low in carotene, the precursor of vitamin A, since corn silage is not high in carotene; timothy and mixed hay are usually low; and even legume hay is apt to be low in carotene unless cured in such a way as to retain its green color. Feeding rations of a higher carotene content in winter results in milk having a yellower color and a higher vitamin A potential. This in turn is a benefit to the consumer of the milk.

2. Storing green crops as silage makes the farmer more independent of the weather, since silo filling can be carried on under weather conditions that would render hay making impossible.

3. First cutting alfalfa or grass silage makes a fine supplement to late summer pastures. The silo is then ready for corn silage in the fall and thus a double use of the silo is secured. Furthermore, since a large tonnage of green material can be handled in the silo, hay storage space is conserved.

4. Losses from shattering and weathering are reduced to the minimum.

5. From a soil conservation standpoint it is advantageous to grow more sod forming crops, such as alfalfa, and a lesser acreage of cultivated crops.

The good keeping qualities of corn silage are attributed to the fermentation process which changes starches and sugars into

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acids. These acids act as preservatives. Grasses and legumes are comparatively low in starches and sugars. Consequently they are preserved with more difficulty than is the case with corn or sorghum crops.

Four different methods of ensiling grass-legume silage have been used at various experiment stations:

Without Preservative.—When the moisture content is neither too high nor too low, it is possible to preserve grasses and legumes without the addition of acids or carbohydrates. About 65 per cent water appears to be the optimum moisture content for this purpose. However, the farm operator runs a greater chance of having spoiled silage by this method than by methods that provide for the addition of preservative. The U. S. Dairy Bureau in its annual report for 1937 states:

"That good silage can be made from hay crops without the addition of other materials and with the use of ordinary haymaking machinery, provided (1) the crop to be ensiled is allowed to lie in the swath and wilt from two to four hours after cutting on a good drying day or longer on a poor drying day, and (2) the material is chopped fine and is kept leveled off and well tramped in the silo so as to expel the air.

"If feeding is not begun at once a protective covering, such as building paper or old newspapers, spread over the entire top, covered in turn by one or two loads of the wettest material available (silage material or fine chopped wet straw) and weighted down with rocks or other material, seems desirable in order to prevent excess spoilage on the top.

"Partial drying of the crop in the field diminishes the losses caused by fermentation and the crop is more likely to produce a silage having a good aroma, but it increases the surface spoilage and loss of carotene."

A. I. V. Method.—The procedure by this plan is to add to each ton of green material 20 gallons double normal solution of four parts hydrochloric acid and one part sulphuric acid. In feeding this silage four ounces of limestone daily are usually allowed to each cow to offset the high acidity of the silage. It is claimed for this method that it conserves to a high degree the carotene content of the ensiled crop.

At the Ohio Experiment Station it was found that the substitution of A.I.V. silage in the place of an equivalent amount of alfalfa gave equally good results in milk production and that the carotene content in the butterfat from cows fed A.I.V. silage for 120 days was two or three times as great as in the fat from those fed the alfalfa hay.

The Wisconsin Station found that A.I.V. alfalfa silage fed to dairy cows through the winter months produced a milk with 50 per cent more carotene and 40 per cent more vitamin A than milk produced on a well balanced winter ration. However, butterfat from cows on pasture contained 50 to 100 per cent more carotene and about 30 per cent more vitamin A than butterfat produced from A.I.V. silage. The cost for the acid, including freight and return of carboys, amounted to $1.15 for each ton of green material ensiled. The process is patented. Chapman Dairies hold the U. S. patent rights. They charge a royalty of $1 a cow a year.

Phosphoric Acid Method.—The preservative used in this case is phosphoric acid at the rate of one and one-fourth gallons (16 pounds) to each ton of green material. It is claimed for this method that the silage is palatable and nutritious. Any excess of phosphoric acid not used in the nutrition of the animal passes on to the manure to increase its phosphorus content. A cow eating 40 pounds of silage daily should pass to the manure about the same amount of phosphorus as is added when the recommended amount of superphosphate, one pound daily per cow, is sprinkled in the gutters.

The Pennsylvania State College filled a silo by this method last fall. This silo has been opened and the silage appears to be in an excellent state of preservation. The phosphoric acid cost from 55 to 60c a gallon. This makes a cost of 70 to 75c a ton for the green crop ensiled. The process is not patented and any one may use it without paying a royalty.

Molasses Method.—By this method from 40 to 75 pounds of blackstrap molasses is added to the green material as it is cut into the silo. This addition of carbohydrates furnishes material for active fermentation as is the case with corn silage. The fermentation results in the formation of acids which act as preservatives. The amount of molasses to add depends on the character of the green crop. Cereal green crops and grasses do not require as large an amount of molasses for efficient preservation as do the high protein leguminous crops. It is claimed for this method that it makes a very palatable and nutritious silage which goes through the normal fermentation process, that it is not necessary to feed ground limestone with it, that it is economical, and that it is effective in conserving the carotene of the green crop.

A considerable amount of research work has been done during the past year with this type of silage.

The Pennsylvania Experiment Station in feeding tests last win-

ter found that alfalfa-molasses silage would satisfactorily take the place of part of the alfalfa hay for milk production purposes. Alfalfa-molasses silage is not recommended as the sole roughage. Unduly large amounts will cause the cows to go off feed and will have too great a laxative effect. If the cattle are gradually accustomed to it, they will then consume 40 to 50 pounds daily or even larger amounts with satisfactory results.

The New Jersey Station found that timothy grass ensiled with 50 pounds of molasses to the ton made a silage that was palatable, higher in protein than corn silage and higher in carotene on a dry matter basis than the dehydrated alfalfa hay fed during the winter months. This they considered important in the production of winter milk of high vitamin A and color values.

The Wisconsin Station tried out molasses-alfalfa silage against A.I.V. alfalfa silage. The two kinds of silage were about equal for milk production and both were superior to a standard ration of alfalfa hay and corn silage. Both kinds of alfalfa silage produced butterfat with a higher vitamin A and carotene content than did the standard ration. The A.I.V. silage was slightly superior to molasses-alfalfa silage in this respect, there being nine parts of vitamin A and carotene per million parts of butterfat with the standard ration, 11 with A.I.V. silage and ten with molasses-alfalfa silage. However, the molasses-alfalfa silage maintained milk flow slightly better than did A.I.V. silage and six cows on the standard ration declining 7 pounds a week, the A.I.V. group 5.6 pounds a week and the molasses-alfalfa group 4.4 pounds a week.

The cost of molasses is approximately one cent a pound, hence the cost for ensiling a ton of green feed by this method is from 40c to 75c depending on the amount of molasses used.

The evidence is so conclusive concerning the desirability of grass-legume silage from the standpoint of increasing color and the vitamin A content in the milk, saving storage space, harvesting the crop regardless of the weather, supplementing pastures, reducing losses that would occur in making hay, and conserving soil fertility that it would appear desirable for dairymen generally to plan on harvesting at least a part of the hay crop in the form of grass-legume silage.

Increasing the Protein Content of Timothy Without Sacrificing Yield

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IN spite of the fact that timothy is considerably less valuable for feeding livestock than clover and alfalfa, this grass continues as the dominant hay plant of the Northeastern quarter of the United States. Until such time as legumes can be developed which are as widely adapted and easily grown as the grasses, timothy and other grasses may be expected to occupy the great majority of the Northeastern hay fields. The principal disadvantage of timothy as a feed for livestock, particularly dairy cows, is its low protein content. A satisfactory method of increasing the protein without reducing yields should therefore be of great value.

Efforts to improve the protein content of timothy by fertilization at the beginning of the growing season have not been successful. Thus, the use of Cyanamid increased yields approximately 1,000 lbs. per acre, and nitrate of soda 1,800 lbs. in a three-year test in New Jersey, but the protein content of the hay at the normal harvest period was not significantly increased. Although the total protein per acre was greatly enhanced by spring fertilization, the quality of the hay was not appreciably improved.

The efforts to improve quality of grass hay by early cutting have been more successful. Timothy cut at the heading stage in the New Jersey experiments averaged 7.11% protein; 10 days later the protein had dropped to 6.45%, and another 10 days permitted a reduction to 5.35%. The latter date was approximately the stage of early seed formation, at which time it is now customary to harvest timothy hay. Obviously, the early-cut hay is more nutritious and palatable. However, the hay yield at the heading stage is 900 lbs. less than for harvests 21 days later.

At the New Jersey Experiment Station preliminary experiments in the field, and more carefully controlled tests in the greenhouse, indicated that soluble nitrogen fertilizers applied at the heading stage of growth might greatly im-

prove the protein content of the crop harvested 10 to 20 days later. These tests likewise showed that nitrogen absorbed by the plant was actually converted to organic compounds, largely protein, and not merely held in the plant sap as inorganic nitrogen.

Careful field tests over a three-year period have now been completed at the New Jersey Experiment Station with a variety of fertilizers to test the feasibility of increasing protein content of timothy at normal harvest date, by applying soluble nitrogen compounds at the time of heading. The broadcasting of 125 lbs. of nitrate of soda per acre, or 100 lbs. of sulfate of ammonia, on timothy about June 15, increased the protein 10 days later from 6.45% for the untreated plots to 7.74% for treated plots. Twenty days after fertilization, the untreated hay averaged 5.35% protein and the treated crop showed 6.74%. In addition to increasing the protein content, the color and leafiness of the hay was distinctly improved. After treatment, the timothy plants soon became dark green in color and retained green leaves at the base of the stems as growth progressed. An additional benefit from the treatment came from the increased growth of the second crop (aftermath). In general, nitrogen fertilizer applications at heading time stimulated nearly 50% additional aftermath.

The timothy plant absorbed nitrogen and converted it into protein fully as efficiently when sulfate of ammonia was applied as with nitrate of soda. These tests were conducted on loam soils of mild acidity and medium fertility. On soils of greater acidity, nitrate of soda would likely be preferable. Calcium nitrate was utilized more efficiently than either of the above fertilizers, for some reason not yet determined. It is suggested that the additional calcium may produce greater efficiency in use of nitrogen. However, this is speculation, and calcium nitrate is not yet generally available.

The effect of season on the utilization of soluble nitrogen fertilizers applied in mid-June was determined largely by the moisture supply. In 1935 when rainfall was adequate and well distributed, 10 days' time was entirely adequate for the absorption of the fertilizer nitrogen and its conversion into protein. Delaying harvest for 20 days after fertilization in years of plentiful moisture, reduced both percent of protein in the hay and the total protein per acre. In dry seasons, the situation was somewhat different. Thus in 1936, a season with limited soil moisture at the time of fertilization and limited rainfall immediately thereafter,

10 days was not sufficient for maximum absorption of fertilization nitrogen. Greater returns were obtained from harvesting approximately 20 days after applying fertilizer at the heading stage of growth.

The amount of aftermath was also controlled largely by the moisture supply. In moist seasons, the second growth was considerably stronger than in dry ones. In all years, however, the earlier harvests permitted the greater development of aftermath. Since the greatest value lies in the hay crop itself rather than in the aftermath, the time of harvest should be adjusted to obtain the most favorable effect on the hay. In general, hay harvest should be made about 10 days after fertilization in moist seasons, and 20 days in dry seasons.

The possibility of using amounts of fertilizer larger than 100 lbs. of sulfate of ammonia or 125 lbs. of nitrate of soda, was investigated. The conclusion drawn from such studies was that substantially larger amounts were not as efficiently utilized as the smaller applications. Further studies may disclose means of inducing greater absorption of nitrogen than was observed in these tests; until more information is available, the use of moderate applications which are efficiently utilized by the hay crop, is recommended.

The principle on which the success of delayed fertilization rests, is that grass plants reaching the heading stage have stored large amounts of reserve foods in the form of starches and sugars, for blooming and seed formation. The addition of soluble nitrogen at this stage permits conversion of the starches and sugars to proteins. By harvesting promptly after the new protein is formed, a higher quality of hay is produced. Since the time period following treatment is short, there is no appreciable effect on yield. The advantages of the method are obvious; a higher quality of hay is obtained and the yield is not reduced. The alternative method of early harvesting at the heading stage produces high quality feed, but at a great sacrifice in yield.

Applying nitrogen fertilizers at the early heading stage of growth is easily accomplished by ordinary machinery for broadcasting fertilizer. To avoid burning, the treatment should be made when the plants are completely dry; afternoon is more favorable than morning. No permanent injury to the crop results from either the tramping of the team, or the wheels of the machine, when treatment is made under these conditions.

A Plan for Livestock Improvement

Condensed from The Jersey Bulletin

C. M. Long

Purdue University

IMAGINE if you can the attention that would be attracted to a colt show at which were exhibited a stallion and five hundred of his colts all foaled in a single season. Imagine the exhibition of a bull with fifteen hundred to two thousand of his yearling calves, or a ram and five thousand of his lamb offspring, all within a few weeks of the same age. Such exhibits could be easily possible, should mechanical insemination become a common practice in livestock breeding. It is possible and probable that the discovery of mechanical insemination and its application to the livestock industry will mean to that industry what the invention of the gas engine and its use in the automobile has meant to the transportation industry.

Mechanical insemination with animals is merely the same thing as hand pollination in plants. In plants this method of reproduction has been practiced so long we have forgotten who was the first person to attempt it. The Russians have been the first to make practical use of mechanical insemination with livestock. Under normal conditions a ram will mate with from 50 to 55 ewes in a season. In 1932 Ivanov of Russia reported that one ram produced 850 lambs and in 1933 a single ram produced 2,500 healthy offspring. In 1935 the seminal fluid of one ram was used to fertilize 5,000 ewes. Mechanical insemination was first used on a dog by Spallanzani in about 1770. In fact, he was the first to prove that the seminal fluid alone is responsible for pregnancy. In 1897 Heape published a review in which he quotes experiments by Millais on the dog and by several American and European horse breeders. However, the development of mechanical insemination in the field of practical breeding is due chiefly to the work of the Russian experimenter, Prof. Elie Ivanov.

Since this work of the Russians has pointed the way to livestock improvement any where in the world, what they claim to have accomplished should be of general interest. In 1919 the Soviet Government founded at Moscow the Central Breeding Station,

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with Ivanov as director. He started his work in 1923 at which time 1,500 mares were inseminated and the number rose steadily until 1926 when 70,000 were so treated. Since then they have continued their work with cattle, sheep, hogs and several kinds of wild animals, with highly satisfactory results. Their most extensive work has been done with sheep. In 1935, 997 cows were mechanically inseminated, 950 coming into calf. Ivanov was a practical fellow and he asked himself how does the mechanical method compare with nature's practice, and set about to answer his own question. Accordingly, 287 cows were inseminated mechanically and 163 in the ordinary way. In the first group pregnancies ranged from 59 to 62 per cent, while in the control group it was 69 per cent. The work with swine showed 48 to 56 per cent effectiveness. With sheep it was uniformly higher, going as high as 88.9 per cent.

This man, Ivanov, who has done most of the Russian work, was curious about several other things. If the seminal fluid was to be transported over long distances the proper temperature at which it should be kept must be known. If a good sire is to be made the most useful, the amount of and methods of diluting the seminal fluid and the extent to which it can be diluted without decreasing its fertilizing power had to be determined. As rabbits and guinea pigs are cheaper than farm animals, much of his work was done with them. At first he supposed a spermatazoon would soon die if kept at a temperature below that of the animal body, and was greatly surprised to find that not to be true. He found that the spermatazoa will survive longest if kept within the isolated ipididymis, a part of the male gonad, at a temperature just above the freezing point. He found that the spermatazoa of the rabbit and the guinea pig if so kept survived about seven days. He also found that the spermatazoa would retain their fertilizing capacity for seven days outside the body at a temperature of 51.6° Fahrenheit. In fact this was the very best temperature to be used. If he was going to distribute these spermatazoa, which we shall hereafter call sperms, to the greatest possible extent he must first know how many there were to distribute. Accordingly he set about to count these. He found that the volume of seminal fluid discharged at one service varied from one cubic centimeter in the case of the ram to 4.5 cubic centimeters in the bull, 80 in the stallion and 120 in the boar. The number of sperms in a cubic centimeter of the seminal fluid he found to be legion—four billion to six billion—or

enough in a single cubic centimeter to fertilize all the females of that species in the world, if it all could be made useful.

How to make it useful was a much harder problem. Ivanov found that most foreign substances, especially water, kill these sperms immediately. Nevertheless he continued his search until two fairly satisfactory dilutors were found. With these he has been able to fertilize from 20 to 40 ewes, 56 cows, five mares and two sows with the seminal fluid from one service of the respective kind of male. He also found that the proper application of the seminal fluid greatly increased the efficiency of the work.

While the work of mechanical insemination was first put on a practical basis by the Russians, all over the world men are working in laboratories and with flocks and herds to improve the methods and find out new facts. In most places outside of Russia the work is in the experimental stage but is confirmatory of the Russian's work.

At the Beltsville Station of the Bureau of Dairy Industry of our Department of Agriculture, Dr. F. W. Miller worked with dairy cattle. He inseminated about 150 heifers with an efficiency of about 40 per cent. The poultry specialists of the Bureau of Animal Industry at the same place are working with poultry, but their results are not far enough advanced for publication. At the Minnesota Experiment Station Prof. L. M. Winter had 90 per cent success in inseminating sheep and a fair percentage of results with cattle. In most of the colleges and universities research men are working on methods of collecting the seminal fluid, dosage and methods of keeping it, and have done very little toward putting the process into practice.

We can appreciate the importance of the discovery and use of mechanical insemination when we realize that man has not made the same progress in the improvement of his plants and animals he has made in improving his machines. While improvement in plants is quite noteworthy, he has made hardly any improvement, chargeable to breeding, in livestock, in the last 50 or 75 years. He can almost breed plants to order. Cotton has been bred for long staple, and to some extent, for drouth resistance. Wheat has been bred to withstand its old enemy, rust. The spines have been bred off of barley and its yield has been greatly increased. It is, however, with corn that the most fantastic work has been done. Stalks with any height of ear can be produced. Likewise stalks that withstand more wind in the fall and more cold either spring or fall. The grains can be changed in both their physical and chemical

characteristics. Short or long grains, dent or flint, low protein or high protein, low oil or high oil content, can be had as desired. This progress has come about because of the re-discovery, some 35 years ago, of Mendel's Law, first discovered by the Austrian Monk, Gregor Mendel, about 75 years ago.

Since the same laws of genetics apply in both the plant and animal kingdoms, one would expect the same improvement in both kingdoms as the results of man's efforts. That is far from true. Most of the changes in livestock, as the changes in the appearance of range cattle, have been due to mixing as in combining paints of two different colors to get a third.

About the time of our American Revolution, Bakewell and Collings, two English cattle breeders, worked great improvement in the beef cattle of their day. The results of their efforts have been handed down to us and it is doubtful if we have made any fundamental improvements since. The great records made in recent years, mostly in this country, with dairy cattle have been due, not to breeding so much as to feeding and management. We have learned to better combine our feeds and to take better care of our cattle but we have done little toward improving their inherent characteristics. It is as if the automobile manufacturers had relied solely on the improvement in gasoline and on the increasing skill of the drivers for the improvement in the speed of their cars. The correctness of this contention will be apparent when we remember that we look backward to Calypso, reserve grand champion at the 1903 International Livestock Exposition, for the Percheron model, to Hamiltonian 10 for supremacy of blood in trotters and to Longfellow for the improvement in Berkshire hogs. The latter two animals lived more than 50 years ago.

The question naturally arises, "Why this lack of progress with livestock in the face of so much improvement in plant breeding?" It is because the problem has been much more difficult with livestock. The plant breeders obtained their pure strains by intensive in-breeding. Because of the longer life cycle of animals and the breeding methods heretofore at our command, in-breeding with large enough numbers to get results has been a difficult matter. Proving what results have been obtained has been more difficult with animals than with plants. It is fairly easy to test the ability of a plant to withstand drouth, insect enemies, or to produce an increased yield. It is a much more difficult problem to prove increased milking ability or ability to make faster gains in the feed

lot. The dairymen were the first to devise a method, through testing associations, of proving the worth of their animals. At first this helped chiefly in feeding, but lately they have learned to apply the results of this test to breeding, and it looks as if they were on the threshold of great improvement. The poultry breeders were next and have made great progress. The Danes have worked out a method of testing sows for prolificacy as well as economy in pork production, which has been highly beneficial. In all this work one thing stands out sharply. It is that we must depend largely for our improvement in livestock performance on better sires. The chief result of all this work to date is to make a vast number of people "better sire" conscious. The results with dairy cattle, the class of stock on which we have the most data, show—according to the Bureau of Dairy Industry—that only one sire in four improves; two merely maintain the existing standards; one actually retards advancement, or produces offspring not as good as his half sisters or his dam. If this is true with dairy cattle where testing has been in practice over 35 years, what can we expect with other classes of livestock where no semblance of testing has been practiced? At the present time the man who has built up a good herd of any kind of livestock is at his wits end to know where to go for his next sire. He realizes that this selection may dash to pieces all that he has been able to accomplish in a life-time. It is this see-sawing back and forth, with one good sire and three poor ones, that has kept the livestock breeding industry practically at a standstill for almost a hundred and fifty years.

That we have in our various classes of livestock the characteristics for high production is shown by the fact that while the average hen produces only about 80 eggs per year, whole flocks average 200 eggs per year; while the average cow produces less than 150 pounds of butterfat in a year, large herds have averaged more than 500 pounds; while the average litter of pigs hardly attains five hundred pounds weight in six months, it is not uncommon for litters to attain 2,000 pounds in that length of time. Individual records with all these classes of stock are far above these figures. The trouble is we have not yet found a way to fix these characteristics so that they will with certainty be passed on from one animal to the next.

It is not merely the fact that mechanical insemination will enable us to produce in the show ring the most gigantic livestock spectacles ever witnessed, that we see in it such promise to the live-

stock industry, but because its application to the breeding of animals will tend to put their breeding on a parity with that of the breeding of plants which, as we have seen, has been so phenomenal recently. In view of the results reported both in Russia and upon this continent, it does not take a very vivid imagination to picture the results that may come from putting this method into practical use with livestock of this country. Previously we called attention to the progress made by dairy breeders through their method of improving sires by means of their testing associations. If they have in this way made progress with their slow natural method of breeding, what would they have done by means of mechanical insemination? Under the methods they have used there have been only one or two bulls that have produced officially tested daughters running into the hundreds, although a bull is often in service ten or more years. By means of mechanical insemination it would be easily possible for one bull to produce ten or twelve hundred offspring in one year, half of them probably females. Thus by the time the young bull is not more than four years old we could know, with a high degree of certainty, his transmitting ability. Under our present methods when a bull has been proved he is not used very extensively. This method would enable his use to the full extent of his physical ability. In the case of horses even with only 50 per cent efficiency, and we have a right to expect much higher efficiency, it would be possible to get two and a half times as many colts as at present. With proper means of distribution there is no reason why the breeding season of the horse might not be extended to more than double its present length, thus doubling again the efficiency of the stallion.

In plant breeding, as we have said, the pure strains used as parent strains have been developed by intensive in-breeding with extremely large numbers of plants. Mechanical insemination should make possible in-breeding with animals, on a sufficiently large scale for comparable results. As yet no one knows how far we can go with livestock in-breeding. The California Agricultural College has a herd of cattle that has been intensively in-bred for 14 years and the Bureau of Dairy Industry has a herd at its Beltsville, Maryland, Station that has been in-bred 20 years. If strains pure for certain characteristics can, by in-breeding, be developed in plants, we have every reason to believe that the same thing can be done with animals where sufficient numbers are involved. If this should prove true,

the way is opened to develop our livestock along any line that suits our fancy.

While enough has been done with mechanical insemination to show that it is practical, all problems connected with it have not, by any means, been solved. The problems themselves challenge the best efforts of those interested in the subject. Of these problems the keeping of the sperm alive and virile for a longer period of time and the producing of ovulation in the female at will are the most important. Work is being done with assurance of success on both of these phases of the subject. I have called attention to the fact that the Russians found the best place to keep the seminal fluid is in the epididymis at almost freezing temperature. It is not practicable to remove this organ and thus destroy the usefulness of our good sires, therefore it is our problem to find out what are the conditions of the epididymis that make for long life of the sperm cells, and reproduce these conditions elsewhere. The problem of producing ovulation at will is important because unless several females are ready at one time to receive the seminal fluid there is an economic waste. When ovulation can be produced at will the production of the seminal fluid and its use can be put on a factory basis. That oestrum is related to a hormone is indicated by work that has already been done. In fact such a hormone has been found. A stumbling block in the way at present is that when oestrum has been prematurely produced it is not always associated with ovulation.

There are many problems not associated with the production of pregnancy that mechanical insemination has already begun to throw light upon. For instance, it has been found that offspring are not only stronger but grow better if conception takes place a certain length of time after oestrum starts. There are doubtless many unsuspected problems associated with the breeding of livestock that mechanical insemination will bring to light and help to solve.

The fact that by mechanical insemination the efficiency of the male may be multiplied from five to fifty times speaks eloquently of its commercial possibilities. In fact, its commercial possibilities would appear to be as great as its physical possibilities. Undoubtedly the breeders of today who have outstanding sires would welcome a chance to co-operate in a method that would at the same time make their sires more valuable as breeders and more profitable from day to day. Each offspring produced by a good sire, if out of a good dam and later tested, would make every

other offspring of that sire more valuable. Methods of producing and quickly proving new sires could be established. Through mechanical insemination the breeders of America have an opportunity of establishing the greatest co-operative breeding association in the world. This should be done in a great co-operative way before private enterprise gets control. Our good foundation stock and modern systems of transportation make the whole continent; if not the whole world; the field of endeavor for a well organized enterprise.

Recently the Bureau of Dairy Industry sent seminal fluid from two of their good dairy sires by airplane to the Argentine. That country is infested in some localities by ticks and mature bulls from this country soon die. This is not the only country that has a disease problem. Nearly all the European countries have foot-and-mouth disease. Asia, aside from Russia, is almost devoid of good livestock. This method could be used to breed up local stocks in the Asiatic countries by means of sires in this country. We have a disease problem here in the form of Bang's disease and many lesser diseases. There are about twenty-four million dairy cattle in the United States. Ninety-eight per cent of them are bred to inferior bulls, many to scrub bulls. In some instances this is because the farmer does not know any better. More often it is because he thinks he is not able to own a good bull. Under a co-operative system he would not have to own a bull of any kind. If each paid his co-operative, using mechanical insemination, for the service what it would cost him to keep a bull of the cheapest kind, it would make a great business for that co-operative. Even if mechanical insemination were used to its utmost, with our present knowledge of its use, there are not enough of the highest class sires to breed all the females of the country. However, if those of the second and third class were also called into service the results would be unheard of improvement in our livestock. We have cited the dairy cattle industry only. There is an equally great or greater field in beef cattle on the ranges. There is another in the sheep industry. Others are in the horse and swine industry while the poultry industry offers a field probably as large as all the others combined. We must remember, too, that all good livestock are not in this country. Holland dairy cattle average nearly twice the milk production of our cattle. England, France and Belgium are noted for their fine horses. There are provinces in Asia that produce pure Angora goats. Mohair from these is entirely free from

kemp or black hairs. There is not a purebred male Angora goat in the United States because these foreign provinces will not permit the exportation of males. Half-breeds do not produce mohair free from kemp. Thus we see there is a great opportunity for both export and import business.

Yes, the business of breeding livestock by mechanical insemination is coming. When it arrives we believe our progress in livestock breeding will go forward by leaps and bounds.

Small Tonics Increase Yields

Condensed from California Cultivator

IN the following article, George Kent points out the value of some of the lesser known chemicals in plant feeding, the need of which never became apparent until poor growth and lower yields developed in some soils despite the increased application of the three chemicals (nitrogen, phosphorus and potash), ordinarily considered the only ones necessary in a balanced feeding program.

The art of feeding hungry acres—giving back to the soil nutrition and enrichment that crops take out—is as old as farming. But during the last twenty-five years science has been at work developing facts and information that may revolutionize the traditional ways of fertilizing the land. Routine shovel feeding is being supplemented by spoon feeding. Dieting the soil with medical exactitude has cured ailing crops where everything else had failed. Farmers have saved millions of dollars. Old farms have been rejuvenated; tired acres pepped up to produce record harvests.

We know that a pinch of boron added to New York muck heals cauliflower of "red rot" disease. We know manganese doubles and triples the output of vegetables on Florida's glade farms. We have proof that copper helps potatoes, that spoonful doses of zinc can control the spread of orange-tree mottle leaf or the ravages of corn white bud, that aluminum is a tonic for peach trees, that magnesium is medicine for ailing tobacco.

But how do these minerals accomplish their miracles? Just what happens within the growing plant? Greenhouses and experimental plots throughout the world, all our federal stations and laboratories are searching for the answer.

Reprinted by permission from the California Cultivator, 317 Central Ave., Los Angeles, Cal., March 26

After thousands of years of soil cultivation, study of the feeding processes of plants is still an infant science. But among the research workers today are those who believe that the right fertilizer can grow sturdy plants immune to all disease—even resistant to insects. Scientifically fed rose bushes have flourished, insect free, while beside them others normally fed have languished under the attack of scale.

And such discoveries run parallel to those of vitamins, hormones and minerals in the human diet. Half of the population, for example, suffers from calcium deficiency—and we cannot eat enough spinach or drink enough milk to supply the nutritive elements that we need. More potent vegetables and milk—these, too, are problems for farmers and scientists.

Way back in the early beginnings when grasses, leaves, stalks and dead wood moldered back into the earth, the soil fed itself sumptuously. As farming increased and each crop began sapping strength from the land, farmers at first moved onto new ground. Later they learned that manure, fish scraps, bones and dead animals renewed the earth—gave back what had been taken.

Then the modern era. . . . machinery. . . . Mass production farming. . . . The emptying of the earth's energies at an appalling rate. With all this came an increase in plant disease and insect pests.

Worse still, the available fertilizer, animal and organic, diminished. But science soon arrived with a formula, for the moment evading a crisis.

Said the scientists to the farmers, the earth contains ten elements essential to plant life: Oxygen, hydrogen, carbon, sulphur, magnesium, iron, calcium, nitrogen, potassium and phosphorus. Don't worry too much about the first seven, these the soil provides freely. Give your farms nitrogen, potash and phosphorus, the famous NKP triad, together with a good liming to correct acidity, and the soil will need no manure. They also stressed crop rotation, nitrogen-producing leguminous plants, along with green manure.

And just when the problem seemed solved, Winifred Brenchley in England announced in 1914 that one hundred thousandth part or less of manganese had accelerated the growth of barley seedlings. At the same time there were other scientific rumblings. The World War made it necessary for us to manufacture our own nitrogen and potash. Outbreaks of strange plant diseases were devastating crops. And years of study had shaken the theory that NKP alone could take the place of manure.

We had learned that in the soil and in plants thirty or more elements were present instead of the ten said to be essential to life. Among these trace elements, manganese, copper, zinc and boron were proved indispensable to the growth of many crops and fruits. As for the other elements, they have been shown to be useful and stimulating. And when we learn more about nickel, tin, strontium, barium, caesium, titanium and aluminum, fertilizer can be compounded with medical accuracy and farming will reach new levels of efficiency.

In their effort to purify their NKP combination, manufacturers of commercial fertilizers had eliminated what two decades ago were considered adulterants or impurities—the minor elements. Farmers applying these "pure" mixtures found their lands declining. Crops dwindled, developed unheard-of ailments. Short of cash, farmers reverted to the stable manures and were surprised to find their farms perk up, become refreshed and invigorated. Scientists, amazed, began experimenting.

In North Carolina, tobacco developed a disease known locally as "sand drown." A dose of Epsom salts cured the ailing plants. Salts contain magnesium, now known to be essential to that sandy soil.

On Florida's deficient glade land, vegetables had been grown for years, fed with a manure brought from the Mississippi Valley. When manure became costly, farmers tried the purified NKP combination—with tragic results. State and federal investigators discovered that manganese added to the triad enriched better than manure did. On one plot without manganese only withered tomato stalks grew; a few pounds of the mineral on an adjoining plot and the yield was over 400 crates.

And, thanks to a fortunate accident, minute doses of copper now promote vegetable growth and ward off diseases. In a field of beans, those half sprayed with Bordeaux did beautifully, the unsprayed beans shriveled and died. Why? Bordeaux contains copper.

Again, in a desperate effort to check the "rosette" disease, pecan trees were being sprayed; half the trees recovered, half seemed bound to die. Scientists found that the healthy half had been sprayed out of a galvanized iron bucket, the other half out of a wooden bucket. Zinc was the benefactor.

Zinc, they found later, stopped frenching and die-back of citrus trees, bronzing of tung trees and white bud of corn. Fifteen to twenty pounds to the acre turned the trick. Simply by driving nails of brass, an alloy of zinc, into citrus trees, mottle leaf and little

leaf disappeared, though the best method is to spray directly. This serves the triple purpose of fertilizer, fungicide and insecticide.

Manganese, shown to be essential to the manufacture of the chlorophyll or green substance of leaves, worked a miracle with spinach in Rhode Island, soybeans and cowpeas in North Carolina, and with silt crops in Indiana and Michigan. Where fields had been overlimed, it proved the only corrective.

Florida experiments have revealed that boron, popularly known as borax or boric acid, is indispensable to nearly all crop plants, although most soils contain enough of it without its use as a fertilizer. Ten pounds of boron to the acre of celery can eradicate the cracked stem evil. Twenty pounds will damage the plants. More than than twenty will kill them. Good results have been obtained with as little as one part boron to two million parts of water.

In New York state, copper sulphate increased the onion yield, thickened the scales, hardened the bulbs and gave tops a richer color. In Maine, it rejuvenated potato fields. In Kentucky, Dr. J. S. McHargue demonstrated that nickel and cobalt were important in developing blue grass. Sulphur, as contained in superphosphates, improved Oregon alfalfa and clover. Florida sugar cane benefited from chromium, barium and nickel. Cowpeas flourished on tin and antimony.

Still other experiments conducted by Dr. John W. Shive in New Jersey recently showed that tomatoes deprived of boron die in three weeks; cotton can make no progress; lettuce dies in a fortnight; tobacco suffers—without boron.

While all these experiments have been going on, fertilizer manufacturers have done much to encourage the proper use of the minor elements in their products. Some of the larger companies now maintain service departments which prescribe for soil deficiencies, make up special combinations to meet special conditions. Discovery that boron was a cure for cauliflower red rot was in part the work of a fertilizer manufacturer. Furthermore, county agents and other experts freely give advice on this new science of plant feeding.

While some optimists believe they will live to see growing in factories of glass, crops rooted only in chemical cultures, the revolution in soil fertilization goes on. Miracles have been accomplished—but an extra-ordinary amount of work remains to be done.

No Pig Wants To Be a "Runt"

Condensed from American Agriculturist

John P. Willman
Cornell University

PERHAPS because they excel other farm animals in the economy with which they convert feed into edible flesh, swine are sometimes referred to as "mortgage lifters." Not only do they make good use of grain and other concentrates; but they also utilize to good advantage a number of feeds that have little or no cash value, or that otherwise would be wasted. Among these are dairy by-products, bakery refuse, garbage, cull beans, cull potatoes, and waste from the garden. They are able also to utilize grain that is not thoroughly digested by fattening cattle, and the pork which is sold often means the difference between profit and loss in cattle feeding operations.

The ability of a pig to give good results in the feed lot is largely determined by his care during the first eight or ten weeks of his life. Wormy pigs, or pigs that become anemic, cannot grow rapidly and efficiently. Pigs that are weaned at eight weeks of age and have had access to their own feed supply since they were three weeks old should be preferred to those weaned earlier and that had to steal feed from the sow. Healthy pigs that were given a "running start" are the kind every feeder should want.

When the pigs get "wormy" many of them are permenantly stunted and the growth of others is slowed up considerably. Pigs may be raised the worm-free way if the sows are clean when they are put into a clean pasture and are allowed to farrow and raise their pigs in clean colony houses in this pasture. If the sows farrow during cold weather the following plan will give you worm-free pigs:

1. Clean and scrub the floors and side walls of the farrowing pen with scalding hot water and lye. Disinfect the pens with a good disinfectant to kill the germs of filth borne diseases. (This washing does not kill the round worm eggs, but it removes them from the pen.)

2. Wash the feet, legs, sides and underline of the sow with soap and lukewarm water before she is driven into the farrowing pen. This is done to remove dirt which may contain round

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worm eggs. A small amount of this dirt swallowed by a young pig may cause him to become a runt.

3. Haul the sow and litter to a pasture which has had no swine on it for at least one year, and preferably one that has been plowed since last used by hogs. When pastures are not available, the pigs may be turned into a small clean pen adjoining the farrowing pen. If the floor of this pen is concrete or wood it may be washed, but if not covered with such a floor, remove several inches of the old dirt to take away the worm eggs dropped in the manure of the hogs that used it before. Replace this dirt with cinders, gravel or a new supply of clean soil. There is little or no danger from loss due to worms after the pigs weigh about 125 pounds each if they have been kept in clean quarters up to this time.

When pigs are raised indoors where they do not get access to the soil during early life, they are apt to become anemic. Anemia is due to a deficiency of iron in the ration of the pig. At birth the young pig has a small store of iron in his tissues, but the sow's milk is extremely low in this mineral, and it seems impossible to increase the iron content of the milk by feeding iron to the sow. Therefore, unless the suckling pig can get it from other sources, he will not obtain sufficient iron for the formation of the haemoglobin (or red coloring matter) in his blood, and anemia will result. When the suckling pig is on pasture, he usually obtains sufficient quantities of iron from the soil and vegetation.

Experiments have shown that anemia may be prevented by swabbing the udder of the sow or by drenching the pigs once a week with a saturated iron solution. This solution may be prepared by dissolving as completely as possible one pound of dried ferrous sulfate (or an ordinary grade of copperas), in one quart of hot water. A two-day-old pig needs ⅓ of a teaspoonful, and as the pig grows the amount can be increased to one teaspoonful. Swabbing the udder of the sow with this solution once daily, or administering the iron solution to the pigs by drenching them once a week until the pigs are six weeks old, have proved to be very satisfactory treatments. When the udders are swabbed the pigs seem to get sufficient iron when they nurse.

Pastures are the foundation of profitable pork production. A summary of numerous feeding experiments shows that an acre of good clover or alfalfa pasture, properly grazed by growing pigs, will save in feed over 1100 pounds of corn and about 450 pounds of tankage. In addition,

some of these pig pastures will yield a fairly good hay crop even though they are grazed by pigs. This is a greater return than such land usually shows per acre when not grazed by hogs.

Alfalfa, clover and dwarf Essex rape or broad-leaved rape are the best pig pastures for this area. Rye, wheat, or a mixture of rye, wheat and vetch may be used early in the spring. Rape is an annual crop and may be sown from oats planting time until early July. Rape needs fertile soil, may be broadcast at the rate of eight to ten pounds of seed to the acre, and is ready for grazing about seven or eight weeks after it has been sown.

An acre of a good stand of alfalfa, clover, or rape in normal seasons should furnish enough pasture for 18 to 20 pigs from weaning time until the late fall. Of course, more pasture is needed when the pigs are not full-fed. A good stand of such pasture will supply two-thirds to three-fourths of the feed needed for open or bred sows in summer.

Artificial Manure

Condensed from New Jersey Farm and Garden

SALT hay, seadrift and other organic material on many farms are often not used to advantage because of their physical condition. Farmers who have a liberal supply of organic material that they find objectionable in its present state will do well to prepare an artificial manure from this product.

The material is usually built in a flat pile layer by layer until it becomes four to six feet high. After about six inches of material has been piled and compacted by tramping, it should be wet liberally with water and sprinkled with the following mixture of fertilizer salts: Sulphate of ammonia, sixty pounds; superphosphate, thirty pounds; muriate of potash, twenty-five pounds; ground limestone, fifty pounds. These figures are the amounts required for one ton of dry material.

Fermentation will begin quickly but the pile should be watched closely to prevent its getting too dry or the temperature from going too high. After suitable rotting has taken place the top should be forked over.

The crushed limestone should not be omitted as it will keep the mass from becoming too acid, which will slow up or prohibit the growth of bacteria decay.

—F. A. Raymaley

Put Manure Where Needed

Condensed from The Michigan Farmer

R. L. Cook

STABLE manure is too often unloaded as quickly as possible in the field nearest the barn. The material is looked upon as something to get rid of and the task is done with little thought as to the type of fertilizer material being applied.

Since average stable manure contains about 500 pounds of dry matter and 1,500 pounds of water per ton, an 8 ton per acre application is equivalent, as a source of soil organic matter to the plowing under of a two-ton crop of straw, stover or hay. It seems logical then to apply the manure to fields which are deficient in organic matter. On many farms such fields are at the back of the farm and they are deficient in organic matter because they have received no manure and are too far away to be used as pasture.

On most farms there are one or two fields which are less fertile than the rest. Usually such soils are badly in need of organic matter as well as plant food. The addition of organic matter by means of green manure crops may be slow because the soil is too poor to produce a good crop, even of green manure. The quickest way to build up such a poor field is through the addition of stable manure as well as commercial fertilizers and green manure.

On many hilly farms applications of stable manure should be confined to the higher portions of the fields. On the steeper slopes where erosion has already removed much of the surface soil, additions of organic matter are badly needed, not only from the standpoint of fertility but as an aid in the control of both water and wind erosion.

A great deal of manure is annually applied as a top-dressing on alfalfa and winter wheat. A study of the characteristics of stable manure as a fertilizer reveals the fact that only in the case of wheat on the sandy soils is this a practice to be recommended. One ton of average manure contains 10 pounds of nitrogen, 5 pounds of phosphoric acid, and 10 pounds of potash. Clearly then the material should be applied where nitrogen and potash are in greatest demand. Experimental results have shown that alfalfa receives no benefit from

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nitrogen as a fertilizer. It follows then that any increases in alfalfa yields as a result of top-dressing with stable manure must be attributed to the phosphoric acid and potash. If that is the case, why not apply these nutrients as commercial fertilizer and apply the manure on fields where the nitrogen may be useful and where the organic matter is needed more than it is on the alfalfa fields?

According to results presented in the Michigan Agricultural Experiment Station Quarterly Bulletin for February, 1936, it seldom pays, on heavy soils, to apply a spring top-dressing of soluble nitrogen fertilizer for winter wheat. This can only mean that the nitrogen in the manure may be wasted if it is so applied. Unless manure is very plentiful, it is a much better practice to make a liberal application of commercial fertilizer at the time of seeding wheat in the fall and apply the stable manure elsewhere.

Because of the fact that a part of the value of stable manure lies in its organic matter content and because decomposition must take place before all of the plant food is available, it is always a good practice to plow the material under as soon as possible. Until it is incorporated with the soil its value as a source of organic matter is very slight and probably as much as 50 per cent of its plant food remains in an organic form, not available to plants. These facts alone should condemn the practice of applying manure as a top-dressing, except in cases where it is extremely plentiful or where it is applied as a soil mulch.

Soda for Shipping

WHEN germs take advantage of the lowered resistance of a weakened, tired animal after a long, hard journey, they produce a feverish condition commonly known as shipping fever. Baking soda, when properly fed to feeder cattle, has shown some interesting results. Records kept on 77,000 cattle shipped from the Kansas City market show that the loss from shipping fever was twice as great when no soda was fed. An ounce of soda to each hundred pounds of animal weight each day for a period of two weeks is recommended. Sick animals should get a double dosage to be administered either in their drinking water, on their feed, or by drenching. This practice, when followed by proper precautions in handling in transit, will save many losses, it is believed.

The Furrow

Answers to Common Questions on Battery Brooding

Condensed from Everybodys Poultry Magazine

Thomas E. Moncrief

ONE chief advantage of the battery brooder is that it reduces the amount of labor necessary to brood chicks. This is of the utmost importance to broiler raisers, since battery brooders make possible the producing of broilers by factory methods. Fuel also can be saved.

It gives weak and timid chicks a better chance to eat and drink, and often can be used advantageously in straightening out backward chicks.

The battery brooder offers a good place to raise cockerels to broiler stage after they are separated from the pullets.

From the standpoint of sanitation, the battery brooder offers a good control of many diseases to which chicks are susceptible. Not being able to come in contact with their droppings, battery-raised chicks generally are much freer of parasitic infections.

In general, there are just two types of battery brooders: one consists of a room in which regular batteries like fattening crates or cages are placed, which is heated to the temperature desired for brooding the chicks; and the second type is a battery having heating units in each tray. In the first type, the entire room is kept at a uniform temperature, while in the second type, the room temperature is usually cooler throughout the brooding period and the temperature is raised and lowered within each compartment. The second method has the advantage that chicks of all ages can be grown in the same room and even in the same battery.

The ease with which the brooder can be assembled; durability of construction; good arrangement of feed and water troughs, both for the convenience of the chicks and the attendant; handy access to chicks inside; good openings for the chicks' heads at the feed and water troughs; good, reliable heating units, with particular emphasis placed on the thermostats; strong floors which will not sag and

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sink onto the droppings pan—all these are items which should be checked carefully.

As long as the room can be kept at a uniform temperature and can be properly ventilated, it need not be a special room. One of the best arrangements is to have a nursery room for brooding chicks up to three weeks of age, a cooler room for the growing birds, and a finishing room, which is still cooler. It is always well to provide a room as nearly identical with that prescribed by the manufacturer of the battery equipment as possible.

The following are the *minimum* amounts of floor space which should be allowed per chick:

1 to 3 weeks old—10-12 inches
4 to 5 weeks old—20 inches
6 to 7 weeks old—30 inches
8 to 10 weeks old—40 inches

One of the greatest mistakes and the greatest source of disaster is crowding too many chicks into the battery. It just doesn't work!

Many poultrymen fail to realize that the comfort of the chicks in battery brooders depends far more upon them than does that of chicks out in a colony house.

Figure 95 degrees at the center of the compartment for the first three days. After the third day, lower the temperature about 3 degrees every three days for the first three weeks. When you get the temperature down to about 70 degrees, keep it there until two or three weeks before marketing, when it may be well to lower it 5 or 6 degrees more. Allow about 5 degrees more at night time, depending upon the age and comfort of the chicks.

Flooding the floor and placing pans of water near the source of heat are two simple methods of raising the humidity. Some poultrymen heating their large battery rooms with large, specially made blowers which force the warm air out into the room, have hooked up water lines to these, and blow the fine, warm spray of moisture out into the air. This system has been found to work very satisfactorily.

It is well to keep the humidity for early chicks as near 60 per cent as possible. It can be reduced gradually after the first two weeks, but should not be allowed to drop below 40 to 45 degrees at any time.

Whether or not you need special ventilation depends upon the size, type, and location of the building in which you do your battery brooding. If your battery building is away from all other structures and has a free circulation of air about it, you might not need any special ventilation devices, whereas, if your battery room is surrounded by other buildings which prevent plenty of fresh air from coming in at all times and hinder the movement

of used air from the room, special fans, flues and other ventilation apparatus might have to be installed.

Using the windows as the only means of ventilation may work in small outfits, but intake and outlet flues with control dampers are often of help and necessity.

Crowding too many batteries into a room and too many chicks into a battery often present serious problems.

Keep plenty of feed before the chicks at all times. Stir up the feed often to encourage the birds to eat more. Buy a feed which you can absolutely depend upon.

Chicks will go after blood once they get the taste of it. Cannibalism can be practically eliminated, however, by painting the windows red and using red or amber colored lights so that everything is made the same general color. By having the inside of the brooder compartments fairly dark, and the lights directed so as to shine brightly on the feed and water, you can stimulate the consumption of feed and water while keeping the birds from picking one another.

Since overcrowding is a source of even more trouble in the battery brooder than in the colony house, do not overcrowd the birds if you want to prevent cannibalism. Too much heat also is likely to cause nervousness, resulting in feather-pulling and toe-picking.

One can't expect battery raised chicks to know all about water fountains, feed hoppers, stoves, and roosts when he transfers them from the batteries to the colony houses. The chicks must be shown where to find the feed and water and heat, and how to roost at night as they get older. It is not wise to move chicks directly from batteries to the range. It pays to give chickens considerable attention when making any drastic change in their housing or management.

Legwork

ON barnyard chores, farmers walk from forty-nine to 135 miles a month, says Ralph Patty, South Dakota agricultural engineer, according to the amount of their labor-saving machinery. The average of 99 miles a month is 600 miles farther, in a year's time, than the best-equipped farmers travel by foot. Worst-equipped farmers go 1,032 miles more.—*The Furrow*

High or Low-Pressure Dairying

Condensed from Successful Farming

Walter Hunt

JUST what is the rational system for feeding a good-producing dairy herd? In farm practice what is the outcome of applying some of the more recent findings of experimental work in dairy feeding, particularly as concerns the quality and proportions of roughages? Does it pay to roll the feed to the cows up to the limit of their capacity, or are there compensations on the side of not stepping on them so hard?

In search of answers from the farm standpoint to problems such questions imply, I went to two successful dairymen who have put into practice both sides of the picture. Nine consecutive years of reliable farm accounts are evidence of their accomplishments:

For several years, Stanley Newhall, farming 120 acres in Steele County, Minnesota, kept a barrage of concentrates, roughage, and silage raining into the feed trough for his 14 grade cows. He was topping the dairy herd improvement association at an average of about 375 pounds of butterfat per cow, but when he got all thru marketing butterfat, a carload or so of pigs which he raised, and some poultry, the bank account did not look good enough at the year's end.

To keep his production machine running at the maximum, Newhall was resorting to purchase of considerable feed every winter, particularly grains. This was all right for feed-dealers in the community (who have to live, too), but Newhall's cash expenses were way too high. He was sinking a lot in that hole labeled "Feeds purchased." Even had he raised all the feed on his own place, his costs would have been considerable.

Four years ago Newhall made the adjustments that have answered *his* problem. The herd average has been reduced to 250 pounds, but four more head in milk have been added. Alfalfa acreage was upped from 4 to 20; he raised soybeans for hay, more corn and barley, less oats, and dropped red clover and timothy entirely. The protein content of the ration has been pushed up without buying it. Bluegrass pasture is giving way to sweet clover and reed canary grass. Concentrates per cow have come down from a top of 3,800

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pounds a year to only 3 pounds in 1936. Cows get all the silage and legume hay they can eat. Yet return per cow above feed cost last year was comparatively good—$70. Grains saved in the dairy program go into the hogs, and Newhall is buying comparatively little feed. Last year his net farm return or operator's labor income was higher by $1,200 than it ever had been.

Newhall learned how to put up hay so it would stay green and bright, keep its leaves better. It has more feed value. He says slow-growing short alfalfa is superior for feed to alfalfa that grows faster and taller; the same is true of silage. Therefore, he plants silage corn early, puts it up before the stalks are dry in the fall, cutting only enough in the field each day to keep the silage-cutter going. It's but a few hours from field to silo. The winter feeding program calls for silage early in the morning before milking; legume hay at 10 A.M.; silage again at 4.30 P.M.; and after the night milking, hay again. When he has soybean hay, it is fed once a day and alfalfa once a day; no feed to weigh, grind, mix, or parcel out. It saves work. Young stock gets a little grain and the whole herd stays in fair flesh. In the fall before the silo is opened, pasture is supplemented with green-cut corn or other soiling crop from a nearby field.

So far the plan seems to have worked regardless of whether feed prices were up or down. And with his new cropping program, Newhall is holding soil fertility and yields.

Over in Dodge County, Elton Smith tells a little different story, He is not "stepping on them" quite as hard as he used to, but he hasn't by a long way dropped all concentrate feeding, and doesn't intend to. A herd average of 425 pounds of butterfat has gone down only to a little under 400. Smith is a farmer-breeder. Farm operations and butterfat sales must carry most of the expense, but his 10 cows are purebred, and sales of surplus heifers and bulls for breeding piece out the income. Smith wishes to keep his cows going not too far below capacity in order to speed sales of stock, and he feels this is worth something in expense and work. Furthermore, he believes that a cow permitted to slip too far below her ability to produce is not being put to her best use, even though she requires concentrates. Another firm belief is that reasonable feeding of concentrates, although they cost more, will make a larger return per cow above feed cost. In this respect he is slightly bettering Newhall's performance, according to the record.

Again, Smith says that if he were to cut down concentrates

further he would be faced with the necessity of enlarging the milking herd from 50 to 100 percent to maintain his present income, which would involve a question of equipment and buildings. He doubts the practicability of the expense of increasing the size of his physical plant. The same problem is met in making use of surplus concentrates from his 160 acres. Unlike Newhall, he has not found it necessary to buy feeds. His hog program is restricted, and surplus grain and hay must be sold. Probably this accounts in part for his generally somewhat smaller total farm return than on the Newhall place.

Smith also has improved the quality of roughage and pasture. It cannot be denied that this is sound practice, regardless of system. Both men have found that they now are getting more return out of forages and grasses. Indications are that Smith is right in his theory that something is lost if cows are not kept going somewhere near their ability to make a right good butterfat yield. Newhall gives evidence, however, that there is frequently a point reached where feeding is overdone, and his use of grain for hogs gives him an advantage in farm income.

Extension dairymen who know these two examples point to the evidence that there is a middle ground (not too near the extremes of either high or low pressure and accompanied by some adjustment of other enterprises) which many farm dairymen can afford to consider.

Birds and Weed Seeds

BIRDS, especially pheasants, are presumed to scatter weed seeds, but experiments at the University of Idaho indicate that the digestive system of game birds is thorough enough to render harmless nearly every weed seed consumed. Chinese pheasants were fed mill screenings containing practically all of the weed seeds common to the northwestern wheat country. Tests showed that, with the exception of one extremely small seed of an unimportant variety, all the weed seeds were digested. Then the pheasants were put on a concentrated diet of weed seeds. The results were the same. Wild morning glory and other particularly noxious weed seeds were included. The seeds were put in small capsules and forced down the birds' throats.—*The Furrow*

Longer Grazing Seasons

Condensed from Missouri Ruralist

George F. Jordan

NEED more pasture? More day's grazing to the acre? Need to carry more animals to the acre? Need pasture not alone for May, June and a part of July, but for the remainder of the year?

Answers to these questions are quite obvious. Now and then we see a pasture under-stocked. More often the reverse is true. We not only need more pasture, we need better pasture, and pasture for more months of the year.

This year Master Farmer E. C. Adams, of Jackson County, Missouri, provided pasture for his more than 100 head of dairy cows for at least 10 months of the year.

Chenault Todd, Howard county, provided grazing for his Shorthorns for nearly 11 months of the year.

In Mississippi county, Manager W. H. Sikes, of Buckeye Plantation, made 140 acres of pasture produce an average of 220 days grazing for 1 animal.

In Southwest Missouri, J. L. Stone, near Neosho, made his pasture acres produce an average of 144.8 days grazing for 1 animal.

Charles Elzea made every one of his 320 pasture acres, in Monroe county, average 85.7 days of grazing for 1 animal; and on one pasture the grass produced was sufficient to have grazed 1 animal for 543 days. That's pasture.

These men not only got more grass, they handled their pasture problems in a way that spread that grass over almost an entire season. And they did it not by one system, or with one kind of grass. Some of them did it without annual or supplementary pasture. Some did it almost 50 per cent by supplementary pasture. Some did it with little more than bluegrass.

But all of them did these things—they didn't over-stock, they mowed their pasture weeds, they rotated as much as possible. Some limed, other fertilized, several did both.

Such are the facts coming to light when looking over the reports these men, and many others, made in the All Year Pasture contest sponsored by the chambers of commerce of Kansas City and St. Louis in 1937 in cooperation with the Missouri Extension Service. Factors consid-

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ered in judging every farm were: Condition of permanent pasture, pasture capacity, balance of pasture system in relation to entire farm, soil erosion control, and improvement in soil fertility.

E. C. Adams, who won the statewide prize in addition to first place in the Northwest Missouri district, has 270 acres in his farm. His herd of dairy cows numbers more than 100 head. Producing a high grade of milk he wanted pasture not only for feed but for putting quality into the product he sells. Out of 270 acres in the farm 236 were in pasture. Knowing grain costs, one can figure the value Mr. Adams places upon pasture for his herd.

The Adams pasture system included wheat, which he pastured off and followed with Atlas sorgo for silage. It included oats which were put in the silo. It also included barley, which was pastured off and followed with Sweet clover, which also gave pasture during the year and will be held over for pasture in 1938. It included oats and rape for his hogs. Of the 236 acres in pasture, 94 were in annual or supplementary pasture such as lespedeza, wheat, barley, oats, Sudan and Sweet clover. This means that for every 2½ acres of permanent pasture, which was bluegrass, Mr. Adams put in 1 acre of other pasture crop. While drouth during the fall cut much of his small grain pasture, still throughout the year he had a fair supply of green feed which the herd harvested.

Perhaps the need of quick, succulent pasture is not as necessary for a beef producer as for a dairyman. For that reason Chenault Todd, Howard county, didn't make plans for such a variety of grass as did Mr. Adams. The Todd farm consists of 720 acres of good land, but which is such that a few years of poor management or continual cropping would place it as rather unproductive soil.

Mr. Todd has 540 acres in pasture. His main reliance has been bluegrass, with which he has timothy and Korean lespedeza. He finds that where fertility is good, the bluegrass crowds other grasses out. Where the stand of timothy is permitted, it outdoes the lespedeza. But where neither timothy nor bluegrass has caught, then lespedeza covers the ground. In addition to his bluegrass, last year Mr. Todd entirely grazed off 30 acres of wheat, which was followed by corn. He also had a 50-acre field of wheat which carried 70 head of cattle from April 1 to May 2.

Mr. Todd did something else to help with fall pasture, which incidentally helped him get around the dry fall. He held his stock off 75 acres of bluegrass and saved it for winter. Early this

month that pasture, although the cattle and work stock had been on it for a month, was still from 6 to 10 inches high, with much green grass.

Summing up, the Todd pastures for the year carried 85 head of cows, 20 yearlings, 15 steers until sold June 20, 11 head of horses and 70 suckling calves. It still was going good December 10. The average number of pasture days for 1 animal on the farm was 56.

The pastures of George Stark, near Arcadia, which won first prize in the South Central section of Missouri, showed the advantage of lime where it is needed. Fertility also was needed, a part of this being taken care of with manure. But on the limed pasture, receiving 3 tons to the acre as far back as 1926, his Ozark acres yielded as high as 172.4 pasture days to the acre. That is something for farmers even on better land to think about.

Another Ozark farm, Sunnymede, near Bismarck, has 126 acres of permanent pasture, which was supplemented with barley and a barley-lespedeza combination last year. The entire farm consists of 220 acres, and on it was enough pasture and roughage to maintain 65 head of purebred Guernsey cows in milk, 20 head of heifers and yearlings, 30 calves, 9 bulls, 3 sows, 24 pigs, 50 horses and 800 hens. The farm provided a total of 24,007 pasture days, or an average for every acre of 69 pasture days for the year.

In the cotton section of Southeast Missouri Buckeye Plantation, in Mississippi county, had a pasture of 140 acres. Of this, 100 acres were in Redtop and Korean lespedeza. The remaining 40 acres were growing lespedeza, Redtop, Alsike clover and timothy. The pasture obtained by beef cattle from this tract amounted to 220 pasture days from every acre, which is good grazing on any man's farm.

J. L. Stone, living near Neosho, who won first place in the Southwest district, has 135 acres of his 205 acre farm in permanent pasture. And he has variety. A man who sows a mixture of Crimson clover, Orchard grass, Red clover and has wild hay coming along with it ought to hit on some grass crop in any year. But to be sure, Mr. Stone limed his land and applied 125 pounds of 20 per cent superphosphate to the acre. And he hit it on all grass crops sown. His acres averaged 112.4 pasture days for the year. One of the oddities of the pasture system on the Stone farm was that no annual pasture was grown, the mixture providing, through one crop or another, grass for the entire season.

For instance, on 31 acres Mr. Stone sowed in March a mixture of Korean, Redtop, timothy, Orchard grass, White clover and alfalfa. He had pasture, with these plants on the land, throughout the year.

From the results of this pasture contest it isn't difficult to see why some pastures are good and some are not. The use of fertilizer, of lime, or manure, of rest for pastures and of keeping weeds down all indicate that these practices pay, not each in itself but all together.

It indicates that even with proper management bluegrass pasture, with some help from small grain pasture with lespedeza sown in the stubble, can be made to provide grazing over much of the year. But such scarcely can be done when the carrying capacity of the pastures is overrated. And here we find that the less the carrying capacity is overtaxed the quicker the pasture may be expected to improve.

With Missouri's many soil types, with the many degrees of fertility one encounters, a model pasture plan for all farms is impossible. But the underlying principles of good grass land production as shown in this state wide contest can be applied on nearly every farm. Grass is our best and cheapest feed. Livestock harvests it. Good grass will come to any man's farm if the owner will pay the cost—the lowest cost, incidentally, of any crop that can be produced.

Peewees Protected

ON a Minnesota farm, feeding lambs are worked into three pens according to their individual temperament. The greedy, assertive ones that crowd into the feed rack go into the top pen. Slower and more timid eaters are put into the next pen. Then, the peewee lambs, which are not large enough to hold their own, and all the unthrifty individuals are cut back to the third lot. Classifying the lambs in this way is said to bring better gains.—*The Furrow*

Lye is a Profitable Servant

Condensed from Southern Agriculturalist

J. E. Stanford

HIGH-GRADE lye is a cheap, handy and dependable sanitation agent that can be used effectively by everyone.

Circular 256 issued by the Extension Service of the College of Agriculture, University of Wisconsin, has the following important statement to make relative to use of lye as a disinfectant:

"Lye (sodium hydroxide) in the form of the high-grade household product has been found to be one of the most economical disinfectants for use on the farm. When used in a cow barn, one part of lye to 150 parts of water, that is, one can of high-test lye to 15 gallons of water, destroyed all germs of the colon and abortion groups within a few minutes. Even when cultures of the abortion germs were mixed with 25 per cent egg white to imitate the discharges of infected cows, the lye solution was effective. It was unnecessary to heat the lye solution in order to do a thorough job of disinfection, although a liberal application of the one to 150 solution was found desirable. Accompanied by thorough scrubbing, lye solution removed the caked discharges and manure from the walls and stanchions. The barn was left clean and free from objectionable odors. For use in the milk house nothing is as good as lye. As already stated, when applied to the floor in the strength just mentioned, it prevents the disagreeable odor produced by the souring of milk. Lye has the disadvantage, however, of not killing the germs of tuberculosis.

"Whitewash, if freshly made from quick lime, is an efficient germicide. Surfaces that are cleaned and then sprayed with whitewash are rendered safe. Carbolic acid and compound cresol solutions are commonly added to whitewash, yet contrary to general opinion do not greatly increase its germ-killing power. If partially slaked lime or limate is used to make whitewash, lye should be added to increase its alkalinity, and make it a dependable germicide."

Among the hundreds of everyday uses of lye we mention the following as being among the most important wherein lye can play a major role if used according to directions: Sheep dip;

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scalding hog carcasses; feeding to hogs, and hog mange eradication; sanitation of milk houses and dairying utensils, separators and milking machines; poultry sanitation and treatment for lice, mites and tapeworms; soap-making; softening water and general laundering; controlling pests such as rats, mice, roaches, vermin and moles; food uses like removing fruit skins, sterilizing canning jars, preparing hominy and lutfisk, and for general purposes too numerous to name here.

Again let us urge that a standard, recognized grade of lye be used always, and that the directions be carefully followed in order to get the most satisfactory results and to be insured against the bad effects that might result from misuse or careless use of the product.

Coarse Mash Against Fine Mash

D. C. Kennard

COARSE mash mixtures are more palatable. In three years of tests conducted here at the Ohio Experiment Station, comparing coarse and fine all-mash rations, the coarse mash yielded an average of 16.5% more eggs and 7.4% less feed was required per dozen eggs. Mention of a coarse mash mixture brings up the question: "Won't birds pick over the mash for the coarser material at the expense of the fine?" It is true they will but with proper feeding this ceases to be an objection. Any mash, coarse or fine, needs to be fed fresh one to three times daily in about the amount that will be consumed before another feeding period.

Frequency of feeding, either of whole grain or mash or both, is necessary for best results during cold weather. To be effective, set the table with only as much grain or mash as will be about eaten before the next feeding period.

One of the most skillful poultry feeders I know of (and he is one of the most successful) feeds sparingly of both grain and mash; the feeders are practically empty at feeding time—so the layers are always keen for their fresh grain or mash. This peps up the birds' appetites which in turn increases laying and livability of the layers.

If there are any secrets about success with poultry they will often be found closely linked with skillful feeding and management.—*Farm Journal*

Individuality Among Hens

Condensed from Leghorn World

Willard C. Thompson
N. J. College of Agriculture

FOR the last two years the Department of Poultry Husbandry has been observing the behavior of laying hens confined in individual cages. Widespread public interest in the possible economy of managing layers in cages has demanded investigations along this line. In the course of these experiments fundamentally significant items have appeared. One of the most important of these is the indication that there is "individuality among hens." The individual fowls within a given flock do not all behave according to a standardized family pattern. The observation of differences in individual behaviors has been made with the thought that such a record might tend to explain certain widely varying situations which apparently do exist when laying fowls are under ordinary floor management. It has been felt also that if the nature of individual variations in behavior were more definitely known, changes might be made which would put flock management upon a more efficient plane.

Pullets comprising the average flock of layers as made ready for the season on approximately October 1 of each year are not always at a uniform stage of bodily development. In the observations here recorded typical laying flock units were set up as might be ordinarily done on any average commercial egg farm. Each pullet was weighed at that time. The pullets were approximately of the same hatch and age, but the body weights ranged from approximately 2.6 to 5.2 pounds—all were S. C. White Leghorns. Most of the pullets weighed between 3.5 and 4.5 pounds.

It was very evident that a fair number of the individuals had not yet reached full body development at the time of housing. Some were undoubtedly late-maturing individuals because of inherited tendencies in that direction. The undeveloped individuals needed ample food and time in which to reach full maturity. They needed to be placed under a system of management which would bring about that maturity in quickest possible

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time and in the safest manner. It is probable that in many a laying flock of pullets the mixture of immature individuals with those which are wholly matured is disadvantageous to the former. Feeding and management are usually set up to take optimum care of the matured individuals.

Individual fowls after reaching maturity appeared to differ widely in temperament; some were much more active and vigorous than others; some were much more alert, courageous, and aggressive than others. They soon became "bosses of the flock." The more timid, backward individuals under ordinary flock management on the floor probably are very often cut off from unrestricted access to food and water, with the result that their production is held at a low level.

In the flocks studied, comprising in all nearly 200 birds, the "timid souls" when placed in individual cages with unrestricted opportunity to eat and drink soon gained in weight and egg yield. In these flocks during the first four winter months, there were no birds with zero production. This shows that average practice should provide for the timid individuals in practically every flock. How this is to be done remains for experimentation to determine.

Careful records of food consumption were kept. Again it was clearly demonstrated that the birds varied widely, although all were of the same general line of breeding and all had been reared under identical conditions. Some consumed three to four times as much food per day as did others. Since each was confined in a separate cage and had free access to food, it is considered that variations in both rate and amount of food consumption must have been largely in response to inherited tendencies and responses to individual differences in need or demand for food.

These figures intimate that poultry breeders in the building of more efficient strains of egg producers may have to get data on the respective potential breeders as to their natural capacities to consume and use food. In other words, there must be added to the breeder selection program, the item of selection for "good feeders." It is no doubt true that the better producers in any flock will be the better feeders. It was found, however, that the correlation between rate and amount of food consumption and egg yield was not as high as one might have expected it to be.

Some individuals use food for purposes other than egg yield. The poultryman must find the individuals which use food efficiently in the production of a large number of large eggs, while

at the same time maintaining health and weight.

It was found that individuals within the flock vary materially as to their preferences between mash rations and grain rations. When given an equal opportunity to consume either or both, some individuals proved to be heavy grain eaters and light mash eaters. Others were just the reverse in character. The majority tended to balance mash and grain intake approximately evenly. It was noticed that the heavy grain eaters were usually the poorer producers and were the individuals which tended to put on an excess of body fat.

Another interesting variation between individuals was found to be that of water intake—some hens were heavy drinkers, while others were quite the opposite. While definite figures were not available as to exact amounts of water intake, *the impression was distinct that the larger birds, the heavier eaters, and the better layers were the heavier drinkers of water.*

Individual hens seemed to vary quite markedly as to physical activity during lighted hours. Some hens were nervous and tended to move about almost constantly, while others were somewhat sluggish and stood in one place or position for considerable periods of time. It is possible and probable that this difference may be a response to inheritance—it may point toward another item to be included in the breeder selection program.

Individuals vary tremendously as to the minor activities of the day. Some individuals are persistent mischief-makers, apparently being led by an uncontrollable sense of curiosity. Others are well-behaved. This point may seem to be of rather questionable value until one remains with a flock of layers for several hours and observes the many peculiar individual habits. It may be that a study of individual behaviors may aid in the building up of the kind of management which will cut down on cannibalism and picking, as well as certain other bad habits which sometimes become established in large poultry flocks.

Among the individuals of the flock, all of which were being managed and fed under identical conditions, there appeared to be wide variation as to the nature, character, and amount of manure voided. Individuals watched daily seemed to continue rather uniformly and evenly day after day in this regard. Certain individuals persistently produced excessively watery manure, while others tended to exhibit a consistent and uniform condition of dryness as to voidings. This item of variation in behavior is worthy of further study because it again

offers another possible item for inclusion in a breeder selection program.

Various hens in this group showed considerable individuality as to shape and size of eggs produced. There was a marked tendency for individual hens to be more or less consistent in this regard, especially as to shape of eggs. Evidence was gathered to support contentions already made by the department that egg size is primarily a matter of inheritance and that much can be done toward flock improvement in this regard by breeder selection. New Jersey Experiment Station Bulletin 621, just off the press, deals with this particular type of variation in detail.

Hens vary widely with regard to innate capacity to stand up under modern egg-production forcing methods. Lack of stamina reveals itself in many ways. Study of the causes and kind of breakdown and the symptoms in each case needs to be made. Individuals do not all show the same type of breakdown.

These ten points of variation in behavior are among the more significant of what may be many more than ten. The ten, at least, do give us food for thought in the mapping of an adequate management program for future laying flocks. When many birds are running together in a large flock, the individual peculiarities of the various members of the flock usually go unobserved. The confinement of hens in cages, especially when combined with observations of their sisters under floor conditions, have drawn attention to individuality among hens as a point in management worth consideration.

Added Value

A 1,000-pound cow will produce, on an average, twelve tons of manure a year, containing the plant food equivalent to 700 pounds of nitrate of soda, worth $12.60; 300 pounds sixteen per cent superphosphate, valued at $2.45; and 240 pounds fifty per cent muriate of potash, worth $4.80, totaling $19.85 in fertilizer annually from the one animal. To get this manure back on the land without loss is to add to yearly profit.

The Furrow

Prevent Livestock Losses

Carelessness Costs $12,000,000 a Year

Condensed from The Farmer

THE livestock industry sustains an estimated annual loss of 12 million dollars from injuries that occur either in shipment of animals to market or in handling from the unloading chutes to the killing floor of the packing house. These injuries vary from minor mishaps that cause simple bruises to the more serious things which result in crippling and death.

Whoever pays the bill in the first instance, it is an economic loss that in one way or another eventually is spread over the entire industry. Much of this loss is due to sheer thoughtlessness. Livestock market interests have been working on the problem for some time. National and regional Loss Prevention Boards have been organized. H. R. Smith, of Chicago, is manager of the National Livetock Prevention Board and W. A. Peck, of South St. Paul, is manager of the Northwest board. A meeting was held in South St. Paul on February 25 to organize a general campaign of publicity and education.

Employees at stockyards and packing plants are being watched and coached to cut down injuries. Whips, canes and unprotected prodding poles are going out of use and being replaced by canvas slappers and prodding poles protected on one end with flexible rubber.

Simple bruises caused by blows from whips, canes and prodding poles are a major cause of loss. Many people who handle stock on the way to market do not realize this, but they would get it very quickly if they could see the discolorations on carcasses from these causes that we saw at the packing house in South St. Paul. These bruises must all be cut out before the meat can be sold. Losses on bruised hams run to as high as $1.25.

Market interests can control handling of stock in the stockyards and packing plants, but have no control over stock in course of shipment.

Farmers can start the good work of protecting stock from injury in shipment in these ways:

(1) Handle the stock quietly and easily when loading.

(2) Do not allow the animals to be clubbed or caned.

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(3) Insist that truckers do not overload or overcrowd.

(4) See that trucks are well bedded.

(5) Drive in all projecting nails in trucks and cars.

(6) See that there are partitions in trucks when different classes of stock are being hauled in same load.

(7) Do not handle livestock like scrap iron.

(8) When trucking do not drive fast on curves and do not start and stop suddenly.

(9) So far as possible patronize truckers who are known to be good, careful drivers and handlers of stock.

(10) When closed trucks are used, see that provision is made for ventilation.

Farmers' organizations, 4-H Clubs, vocational high schools, truckers' associations, market interests, railroads, the farm and daily press are being asked to join in a general campaign to cut down shipping losses of livestock.

Fence Security

Condensed from Capper's Farmer

Frank J. Reynolds

IF a few fundamentals underlying wire-fence construction are observed, a farmer can build a fence for less money than otherwise. Moreover, a fence so constructed will last longer, look better and supply more security to crops and livestock than will an ordinary one.

Among such fundamentals are: 1—The end or corner posts are the foundation of the fence. They must be set so they will not give or lift. 2—Intermediate or line posts are intended only to hold the fence up and to keep it in place. 3—Tension curves in the wire should be pulled to about one-half their normal size. They are the "springs" of the fence. They take care of expansion and contraction resulting from changed weather conditions. Tension curves also distribute the shock when the fence has received a severe blow. 4—The fence should be high enough to keep livestock from reaching over and low enough to keep it from going under. Wires must be spaced close enough to keep stock from reaching through. 5—The inside of the fence roll should be put against the face of the intermediate posts. 6—It pays to use good material. The farmer who follows these rules in constructing a wire fence will be well repaid by the

Reprinted by permission from Capper's Farmer, Topeka, Kansas, March, 1938

extra long service it will give him.

Many farmers believe they will have better fences if they place large, deep-set posts a few feet apart in the line, stretch the wire until it sings, and fasten it tightly to the posts. Farmers who follow this plan have good fences for about one season only. Part of the tension curve must be left in the fence when it is stretched or it very likely will break when cold weather causes it to contract. If it does not break, it will become baggy when warm weather expands the steel.

If the fence is stretched too taut and attached too tightly to large, inflexible posts, action of the tension curves is reduced. Flexible steel posts allow these crimps to act more freely. The more flexible the fence, the more abuse it can stand without injury.

If the corner posts are set securely so they will not give or lift, inflexible line posts are not desirable. It is only necessary that line posts be strong enough and set close enough together to prevent the fence from sagging or lifting from the ground line.

After the end or corner posts are set, if barbed wire is to be used, one strand should be stretched from one end to the other to make a line for setting intermediate posts. If wire is not used, a string may serve as a line.

When steel intermediate posts are used, they should be driven to within 2 or 3 inches of the desired depth. By leaving them at this depth until the fence is attached, it is not necessary to work in the dirt to attach the bottom wires. This practice also eliminates measuring to see if the posts are set deep enough.

After the line posts are all set, the woven wire must be unrolled. It is important that new woven wire be unrolled in such a way that the inside of the roll will lie against the face of the posts when the fence is up. If this is done, the fence will work toward the posts when it is being stretched. It is difficult to attach the wire and to keep it from bagging unless the inside of the roll is laid against the posts.

Woven wire fence may be stretched by a tractor if the farmer is careful not to overstretch it. Some light wire fences can easily be over-pulled that way.

With fences of more than 20 rods, it generally is a better practice to pull the wire together at the middle with a double stretcher. If the fence fouls in the brush, or if something requires a trip along the line, it usually is easier to reach the point of difficulty from the middle position than from one end.

After the fence is pulled to the proper tension, a few extra turns on the stretchers will give plenty of wire for splicing the ends to-

gether or splicing the fence to the end or corner posts. Neater splicing may be done with a regular fence splicer. It always is better to splice the ends together by wrapping them around one another than it is to join the wires by loops. After the fence is spliced, the stretchers should be slowly released. This will equalize the tension.

If more than one strand of barbed wire is used, it should be unrolled and stretched after the woven wire has been spliced. Most persons over-pull barbed wire. When stretching it is well to draw it just tight enough to handle it easily. About 250 pounds of tension is the correct amount on 12½ gauge barbed wire.

All barbed and woven wire may be stretched and spliced before one begins to clip the fence to the posts. If this is done, it may all be clipped with one trip down the fence line.

One always should put the first strand of barbed wire not more than 1½ inches above the woven wire. This keeps livestock from crowding between the woven wire and the barbed wire and from mashing the fence down.

When attaching wire to steel posts, one should work from the top of the post down. Then all of the wire will be attached at a uniform distance from the top of the post. Finally, one must go along the fence with a sledge and drive the posts down to bring the fence to the desired distance from the ground line.

One does not often erect a fence, and once put up not only is long service expected but appearance becomes a matter of pride. The few suggestions given here, if followed, will contribute both to long life and continued neat appearance.

Dry Ice

A southern farmer has discovered an easy and effective way to kill gophers. He takes a piece of dry ice, places it in the gopher's hole or runway, pours some water over it, and the resulting carbon dioxide does the rest. This gas penetrates through the gopher hole and smothers the occupant.—*The Furrow*

Game as a Cash Crop

Condensed from The Southern Planter

Dr. Ira N. Gabrielson
Chief, U. S. Biological Survey

RAISING small game as a farm crop isn't as difficult and complicated as it may sound. It is simply good land management that provides for quail, pheasants, rabbits and other wildlife in addition to crops already produced.

Today, some farmers "cash in" on their wildlife crops by organizing game-management associations and selling hunting privileges to sportsmen, and many other farmers are becoming interested in the possibilities of such a venture. Hunting is regulated so that enough breeding stock will be left over at the end of the season to produce game for the following year.

The revenue that may be realized from the farm supply of game, fur animals, or fish may be relatively high in some cases. A large proportion of the money the farmer receives from the sale of wheat, corn, pork and dairy and other products must go to pay the costs of labor, seed, and fertilizer used to produce the crop or products. On the other hand, the cash received for shooting or fishing privileges, while it may not be great in amount, or from harvesting the furs of skunks, muskrats, minks, foxes, or raccoons trapped on the farm, is nearly all clear profit, for the production of these crops has cost the landowner little in money and labor.

Actual practice as well as experiment, has shown that wildlife is one of the easiest crops to grow. Land itself seems to prefer growing this kind of crop, and would still be producing it abundantly, had not the advance of civilization interfered with nature's original scheme. For ages past the land has produced wildlife naturally just as it has produced forests or grass or wild fruits. It will produce the same things again, even near civilization if given a fair chance.

But how can game be managed profitably? Farmers want to know how they can handle this kind of crop so it will be a paying proposition.

First of all it must be realized that if small game is to be hunted it must be produced by the land-

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owner, and the sportsman must be willing to pay for the privilege of hunting it. Open game country and free public shooting grounds are almost a thing of the past in many states. Sportsmen are beginning to realize that the farmer who produces the game is entitled to some sort of return for the use of his land and services. They are also learning that only under such conditions can they be assured of hunting in the future and of game in sufficient abundance to maintain the attractiveness of the sport.

Farmers should have no more hesitation entering into such programs involving the pheasants, quail, or rabbits produced on their land than they do in selling wheat, poultry, or butter. Many state game commissions are willing to help develop game management programs in co-operation with the farmers.

A game crop is not and should not be dependent upon an expensive artificial brooder outfit. With very little encouragement game birds will multiply on an area devoted to their use if the natural surroundings are suitable for their propagation. This means that game birds may be increased in numbers by leaving for them small spots of ground in a natural state. Suitable small spots useless for general agricultural purposes are present on nearly every farm. Few farms are entirely free from ditches, eroding hillsides, rough land, or brush patches where game food and even cover can be provided. If those spots of vegetation were left to nature they would serve as cover and food patches for game. It would be better yet if they were planned and planted for game use.

In some instances letting these waste lands grow into natural vegetation is enough—the natural environment of game is restored, and the spread of erosion to still-valuable land is stopped. A little timely aid on the part of the landowner in seeding and planting these waste spots with quick-growing plants and trees that furnish game cover, game food, and erosion control will greatly hasten the benefits to the farmer and at small cost. A little attention paid to the common feeding, wintering, and nesting habits of game birds will guide one in the proper development of these natural areas and increase the chances that game will actually occupy them.

A question that will naturally occur to the farmer who has only a light population of game on his land is this: "Where will the game come from to occupy these new environments?" Not infrequently a few pairs of birds or mammals already exist in the neighborhood, and by natural increase under protected conditions these few will multiply and es-

tablish a family in each one of the new homes provided.

Game can be introduced by trapping or by the purchase and release where it will colonize, but the cheapest and easiest way to stock the new homes is to provide—by means of hedgerows, bushy ditches and gullies, uncut strips of forage, and attractive cover—plenty of safe cover and routes over which the game can travel at will about the farm without being forced to cross wide bare spaces. Only a little study is needed to show where these trails should run and how to make the best use of the natural features of the land.

In most cases the farmer owner or tenant already knows the general areas where game exists on the premises. As he goes about his daily work he discovers that a covey of quail has its headquarters in an old orchard or in a fence corner thicket at the edge of the wood lot. If he lives in ruffed grouse country he learns to expect birds to flush from a ravine in a pasture where alders, sumacs, grapevines, and evergreens grow. Pheasants he finds regularly along fence rows beside the grain fields or in swales and along brushy banks. Similarly, he will find in their chosen environments the rabbits and squirrels, the fur bearers and other wild things that live on the farm, and he doubtless already knows in what kind of environment to look for each.

There are reasons for all these creatures living where they do. They do not "just happen" to be where they are found, and it is not hard for the farmer to discover the conditions that hold the game in those favored spots. These conditions are invariably concerned with cover, food and water, all so situated as to be available to game the year round. Usually it is easy to improve the arrangement so that each of these areas will support more game. Similar environment also can be built elsewhere on the farm—in gullies, thickets, creek bottoms, wood lots, hedgerows, windbreaks, and similar spots—where before there has been no game because of lack of cover, food, water or perhaps all three of these essentials.

There is probably no land that cannot be brought into game production if enough time and money are spent on it; but the average farmer must keep such expenditures within practical limits. Moreover, any plan for game management for the average farm must take into consideration the cropping systems and must be coordinated with practical farming operations. The success of any game management program depends, however, on the extent to which an area can be made to reach its maximum

in game population. To accomplish this it will be found well worth some extra time and effort to chart each individual farm included in a game-management area.

Charting a farm for game management includes noting all fence corners, abandoned roads, erosion areas, springs, water holes or creeks, ditches, underbrush, orchards, wood lots, forested areas, and waste lands, and the general use to which the farm fields are put. Having such a chart at hand a good game technician can, with remarkable accuracy, assist in estimating the number and kinds of game that can be produced on the area. Most states have game technicians on the field staff of the game commission, men who can be called in to advise as to the kind of game best suited to the property and who will welcome the opportunity to aid the landowner. Advice and help in the business of planning one's land can be obtained in many sections from county agents. Local game wardens and conservation officers also are in position to give assistance.

The Federal Bureau of Biological Survey can furnish information through its research workers and regional officers on game management and has recently established in a number of states co-operative wildlife research units where such help can be obtained. Such co-operative units are now maintained at the Virginia Polytechnic Institute at Blacksburg, and at the Alabama Polytechnic Institute at Auburn, which not only serve the farmers in Virginia and Alabama but also in adjoining states. Farmers living near erosion-control demonstration projects or C. C. C. camps of the Soil Conservation Service will find the technical staff of that Service always ready to aid in the solution of their problems. Two handy Farmers' Bulletins, one (1759) on "Game Management on the Farm," and the other (1719) on "Improving the Farm Environment for Wildlife," have been published by the U. S. Department of Agriculture. Free copies may be obtained from Congressmen.

Farmer Co-operation Pays

A farmer can undertake game management alone and benefit from it, but the best results are obtained when several neighboring farmers join in a co-operative effort on a 1,000 to 3,000-acre tract. Concerted action by a group of neighboring farmers who enter into a game-management association and for mutual benefit agree upon a common rate of charge for the hunters will be found to be not only acceptable to the hunters in most communities but greatly appreciated

by them as they will be more than paid back by the improvement in the hunting resulting from game management. Furthermore, group agreements as to charges relieve the individual farmer of embarrassment.

Holders of small farms will find it advantageous to join with their neighbors in game-management projects. Each owner will then benefit from the efforts of the others, and the problems of stopping poaching, controlling natural enemies of game, and regulating shooting will be easier to solve. Members of the group can co-operate also in arrangements for food and cover crops along farm boundaries and for the management of these strips. Oftentimes when a large area is being managed for the production of game in this way it is possible to organize groups of sportsmen in nearby villages and cities who will rent the privileges season after season. This assures the landowner of permanent patronage and at the same time gives them an opportunity to restrict their dealings to customers whom they know to be honest and fair.

Iowa Has Model Plan

In Iowa the game commission has tried a plan for the management of farm game that provides for the essential co-operation between the landowner, the sportsman, and the State conservation agency. There seems to be no reason why this plan, or some modification of it, should not be equally satisfactory in any state where the necessary qualified game technicians are available.

Groups of farmers are organized into game-management units. When a unit has been established the State game department posts the combined properties and protects the area against poaching and unauthorized trespass. State game technicians inspect the unit and advise the landowners what to do for improving food and cover and for controlling natural enemies of game. They also indicate any other steps necessary to prepare the land to produce the crop without disturbing too much of the regular work of the farm. The State may sometimes furnish eggs or game to restock areas that have no native breeding stocks.

When the time comes that there is sufficient surplus of pheasants, quail, or rabbits to permit some shooting without diminishing the numbers necessary for breeding stocks, the State's game technicians make a survey of the unit and determine how many of each species may be safely taken off.

For example, game management unit No. 3 is found to have 300 pheasants, 500 quail, and 800 rabbits as surplus over the numbers required to produce

next year's crop. The State game department then furnishes the farmers of their association with 300 pheasant tags, 500 quail tags, and 800 rabbit tags— each tag legalizing the taking and possession of one bird or other game animal, as specified. The farmers whose lands are within the unit either sell their own tags direct to the hunters or in some cases elect one of their number to act as their agent in all dealings with sportsmen.

Some days before the shooting season opens, State agents post signs at suitable intervals along the highways and county roads directing the sportsmen how to reach the farmer or his agent. On shooting days as the sportsmen arrive and are shown where to park their cars, each one purchases as many tags as he wishes, but not in excess of the daily bag limit allowed on any species by State law. One sportsman perhaps does not want to shoot rabbits but would like to take his limit on quail and pheasants. He is given four pheasant tags and eight quail tags, paying perhaps 50 cents each for the pheasant tags and 25 cents for the quail. For rabbit tags he would pay, say 15 cents each. The prices, of course, should be established in accordance with local conditions. At the close of the day each gunner shows his bag of tagged game to the farmer or his agent and is reimbursed for any unused tags that he may turn in.

When the supply of tags issued for the season is exhausted, the shooting season on that unit is closed, and the direction signs along the roads are removed. Then the State's game technicians go over the area to observe the results of the shooting and advise the landowners how to carry their stocks of game through the winter. If there is not sufficient supply of natural food, feeding must be resorted to, and the technician gives instructions as to where the food should be placed and in what quantity and variety.

The State of Pennsylvania is experimenting with a variation of this system whereby the farmers on these game-management areas are paid to plant food strips, fence stock out of game cover, plant cover, or to do whatever can be done to improve the game crop on these areas. The State patrols the area to prevent vandalism, shooting about farm houses, excessive hunting, etc., and the results are encouraging other farmers to join in the program.

These are only two of several types of such experiments that are under way in many states.

Our Expanding Farm Markets

Condensed from The Furrow

Richard L. Brown

THE decrease of natural resources in this country has made industry turn for help to the organic chemist and the farmer—the greatest producer of raw materials in the world. Even now, some of the by-products of the farm are being converted into things more important than the orginal crop.

Fifteen percent of the corn crop is converted to industrial purposes; and the phenomenal growth of the soy bean crop in the past few years is due, in part, to its many applications discovered in the chemical laboratory.

Chemistry can separate atoms one from another and recombine them in such a manner as to build up materials which will be more useful, more available, less costly, or more suitable than those conveniently found in nature. It can even produce many new substances which have been found nowhere in nature. All such new and old compounds are called synthetic—that is, they are mixtures of simple elements into complex substances.

Corn subjected to mechanical and chemical treatment, produces dextrin, adhesives, and corn sugar (glucose), as well as oils and solvents. From corn is produced a rubber substitute; and corn proteins are used in finishes, plastics, food coating, and chewing gum.

All denatured alcohol comes from either grain or blackstrap molasses, a product from cane.

The hulls of oats yield furfural, an important starting point for making plastics, and used to a great extent in purifying lubricating oils. Furfural is also made from corn, wheat, rice, cottonseed, and sugar cane. Fibrous stalks, such as waste sugar cane, from which the sugar has been extracted, form the raw material for making useful wall board and insulation. The waste skimmed milk of creameries is treated to produce both milk sugar and casein, and the latter is the base of adhesives, plastics, and quality paper coatings, and even the raw material for a "synthetic wool" in Italy. Skimmed milk and soy bean meal are sources of casein glues. Starchy vegetables, especially corn and potatoes, supply dextrins and other modified starches of valuable adhesive properties.

Soy beans, tung nuts, maize,

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cottonseed, flaxseed, and castor beans are some of the crops that yield valuable oils. Artichoke, Perilla seed, and peanuts are among the long list of other farm products that have industrial possibilities. Peanuts, for instance, can be turned into 300 useful products, including wood stain, cloth dye, linoleum and synthetic rubber.

A result of chemical experiment has been the recent development of the paper industry in the South, supplied by slash pines which grow so fast they may almost be considered a farm crop. Within two years, sixteen new mills have been launched in the South, all using southern pine as raw material. This country need never again be dependent on outside nations for sources of wood pulp.

As a by-product of the utilization of cottonseed, large quantities of linters (cotton fibers left on the seed by the gin, but too short for use by the textile industry) are recovered. These are admirably adapted to the use of the chemical industry in the manufacture of the synthetic fibers of rayon, plastics of the celluloid type, and the nitrocellulose used in quick-drying lacquers and in smokeless powders. Exploring the mysterious realms of atoms and molecules, chemists know how to take plant cells apart and then put the material together again to make pyroxylin, an entirely new substance. Pyroxylin in transparent or colored form is molded into toiletware, pipe stems, hair ornaments, toothbrush handles, and an endless list of other objects. Transparent sheets of it are sandwiched between two plates of glass to make shatter-proof safety glass. Other cellulose products are moving picture films, finishes to take the place of paint and varnish, transparent cellophane wrapping used so extensively in modern packaging, and rayon, the chemically made yarn.

Rayon is a strong, smooth, cylindrical fiber made by man in about the same way that nature makes silk. Man gets cellulose from wood pulp and cotton linters; nature uses the leaves of mulberry trees to produce protein silk via the silkworm.

When man makes these fibers, their dimensions, strength, and other characteristics can be varied at will. Furthermore, rayon is uniform, since its production can be controlled all the way. Most important, it lends itself to combination with silk, wool, and cotton.

Rayon is a truly synthetic fiber. It serves in products varying from parachutes for aviators and wall papers for homes to ribbons for typewriters, linings for coffins, fish nets, and tennis racket strings. So far, rayons

have about 450 uses. Tire manufactures are testing tire cores composed of high-heat-resistant rayon.

Weather-resistant cellulose garments, with perforations around the bottom of the "skirt," are proposed for fruit trees. Attacks by insects will be thwarted, and an application of spray on the material to last several days will carry each tree through a cold snap.

One scientist has made the statement that, apart from the uses of cotton linters as vegetable fiber, there should be 3,000,000 new acres of cotton within the next ten years to fill the need for a material to be used as a foundation in road construction.

To date, no farm crop is so well fitted for use in industry as the soy bean. Aside from its high value as feed and its place in the human diet, products made wholly or in part from soy bean oil and meal include "everything from hay to hairpins,"—soaps, paints, varnishes, lubricating oils, a binder for cores in iron foundries, plastics, paper sizing and coating, glue, rubber substitutes, printing inks, wall coatings, insulating material, linoleum, glycerin, and hundreds of others.

A lustrous, tough, and permanently elastic enamel derived from soy bean oil has a special place in the automobile industry. Refrigerators finished with baked soy bean synthetics have a true porcelain appearance.

Soy bean production is at present concentrated largely in the Corn Belt states, but this valuable crop is also grown to advantage in the South, usually in rotation with cotton.

Chemistry is keeping a more or less optimistic eye on two sugars: dextrose, from corn, and levulose (fructose), from the Jerusalem artichoke. Dextrose already has won a considerable market in the candy and bakery trades, and in canned and preserved goods. It is only about three-quarters as sweet as ordinary sugar, but that characteristic gives it an advantage in some cases, such as in the manufacture of certain preserves and candies which heretofore have been too sweet. However, for the general household use, dextrose is not, and probably never will be, sweet enough.

Raw oat flour, sprinkled on or mixed with various kinds of foods, keeps them from growing stale or rancid rapidly. Potato chips, coffee, bacon, salted nuts, salad dressings, margarine, and other foods offer a brand-new outlet for this flour; it can even be milled right into oiled wrapping paper and thus aid in keeping butter and other products fresh and sweet.

Another use has recently been

found for furfural, obtained from oat hulls, in the treatment of bathing beaches to prevent "swimmer's itch." The same chemical is used in swimming pools, locker rooms, and other sites of possible infection to prevent the spread of "athlete's foot."

A new use for flax fibers in the production of fine quality, lightweight papers, such as cigarette paper, seems to be starting. California is now growing flax for this purpose, and the crop is being revived in Oregon, as well.

Similar thin papers also can be made from hemp. In Minnesota, some hemp is under cultivation for this purpose. Scientists have shown that American flax and hemp fiber is suitable for the making of lightweight paper, and they state that the industry eventually can use fifteen to twenty thousand tons of this fiber yearly, when and if it is grown.

The name plastic is used for any molded substance which begins as some commonplace raw material—such as wood fibers, soy beans, the stalks of various plants, cotton, or furfural—and then passes through complex chemical processes to become finally a tough, solid material which is pressed into all sorts of products. Only fifteen years ago, the plastic industry was still a small one, chiefly interested in making buttons from milk casein. Now, from cellulose materials come clock cases, door knobs, ash trays and ornaments of many kinds, radio parts, portions of furniture, dishes, automobile parts, and hundreds of other things.

There is talk of using sheets of plastic for building purposes, particularly for insulating and interior work. Nearly all the automobile manufacturers are employing plastics to some extent. Soy beans are used for making molded products such as gearshift knobs, horn buttons, electrical switches, and distributor cases. Great molding machines are going to make automobile window frames out of soy bean stalks.

By combining the talent of its research laboratories, the productive capacity of agriculture, and the resourcefulness of industry, applied chemistry may have discovered a formula that will advance our standard of living beyond any that we have known.

It Pays to Insulate

What to Expect from Insulation—How to Select the Materials to Be Used—Suggestions on Construction

Condensed from The Poultry Item

C. E. Lee

THE reasons for insulation can be summed up in one sentence: "Insulation is needed to help maintain as nearly perfect temperature and air conditions as possible and at the least cost."

No poultryman needs to be told that climatic conditions in most parts of the United States are such that winter temperatures are too low for birds confined in open houses to give the best production. Also, temperatures in summer are often too high. This affects egg production, size of eggs, and flock mortality.

If we could provide all the year around such pleasant conditions as we have during a certain part of the spring or early fall, there is no question that birds would make a higher average production at a lower feed cost per dozen, and with resultant greater profit to the owner.

Insulation not only keeps the poultry house warmer in winter and cooler in summer, but it is especially valuable in preventing sudden temperature changes. Experiments at Cornell University showed that hens can adjust themselves quite readily to gradual changes in temperature, but that sudden changes do affect egg production. The experience of practical poultrymen substantiates these findings at Cornell in every way. Adequate insulation will prevent such fluctuations of inside temperature, even though the outside temperature changes very suddenly.

To secure adequate ventilation we must have as much difference as possible between the inside and outside temperatures. If the air inside the poultry house is kept as warm as possible in contrast to the outside air, it would be much easier to secure adequate ventilation. Furthermore, the incoming outside air will be warmed as it enters the pen and will expand and will thereby be able to take up additional moisture. If we take in cool, moisture-laden outside air, and it remains cool in the poultry house, it can-

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not pick up additional moisture and therefore the house remains wet. In fact, the intake of too much cold air, particularly if that air already carries considerable moisture, may so cool the air in the house as to produce condensation of moisture on the walls or ceiling of the house, and also on the litter, making the house thoroughly uncomfortable and adding to the difficulty of maintaining proper sanitation.

Insulation, therefore, permits adequate controlled ventilation resulting in a healthier flock and increased egg production, and this has the advantage of continuing to pay these dividends during the life of the structure. We think commonly of insulation as keeping out the cold in winter and keeping out the heat in summer. Actually, we are simply concerned with the transfer of heat. When two objects of different temperatures are placed near each other, there is an exchange until both are of the same temperature. This is a fundamental law of science.

Cold is simply the absence of heat, so what we are trying to do in the winter is to keep the heat inside our house from passing to the cold air outside, and what we are trying to do in summer is to prevent the heat from outside passing into the house.

Insulation is used to stop heat from traveling from one place to another, or one object to another. A well insulated wall will keep the heat on the inside of the house from being transferred through the wall to outdoors, and, in summer, it will prevent the heat from the sun passing through the wall into the interior to make it uncomfortable for the birds.

Heat travels in three ways, by conduction, by convection and by radiation. If we can so insulate that we prevent all three of these, we will get the highest efficiency. If our insulating material protects only against one or two of them, it will be less efficient.

Conduction is the transmission of heat by contact.

The ability of different materials to conduct heat varies very widely. As a general rule, the more dense the material, the faster the heat will travel. That is the reason why heat travels more readily through metals than through wood, and more readily through wood than through open fibrous material such as a piece of bamboo or cornstalk. The part of the heat that travels through the outer walls of the house travels by conduction.

Convection is another important means of heat transmission. This refers to heat traveling by air currents. The rising of heated air from a radiator or stove is an example of heat travel by convection. The warm air rises and

transfers its heat to whatever it touches.

There is some heat travel by convection through the outside walls of the house, because most walls are more or less hollow.

Air in this open space has a tendency to flow down over the colder of the two surfaces, and upward against the warmer surface. This carries heat from the warm to the cold surface. In other words, it transfers heat from the outside air to the inside of the house in summer, and it operates to transfer heat from the interior of the house to the outdoors during the winter, just the reverse of what we want in order to keep the birds most comfortable.

Radiation is another method of heat transmission. Where heat is transmitted by radiation, it will penetrate thru the air to the nearest solid object without noticeably affecting the temperature of the air. When a building is not insulated, a part of the heat traveling thru the outside walls is by radiation.

To effectively measure heat-travel we should test materials for their efficiency in preventing heat travel by conduction, by convection, and by radiation. Wide differences would be shown in their ability to insulate against travel of heat by these different means.

The ordinary method of measuring the value of an insulation material is by checking the conduction of heat in terms of British Thermal Units. The British Thermal Unit is the standard unit of heat used all over the world and is the quantity of heat required to raise the temperature of one pound of water, one degree Fahrenheit.

In the ordinary method of testing insulation a hot plate and a cold plate are used. The material being tested is clamped firmly between the two metal plates and the temperature difference of the plates is kept as uniform as possible during the period of the test. By various laboratory instruments the amount of heat which passes from the hot plate through the material tested, to the cold plate, is measured, and from these measurements the insulation value of the material is calculated.

There are some other angles to this measurement of efficiency of insulation. Some insulating materials have a high resistance to the infiltration of air, while some have a very low resistance. One of the popular insulation boards has proved so resistant to air infiltration that from 18 to 112 times more air was found, on test, to be passed by other common insulation boards. When a strong wind is blowing, the insulating value from the B. t. u. standpoint, based on the "Hot

Plate" test means very little if the material is porous, permitting the easy passage of air. In other words, the material must resist convection.

Many insulating boards have a high Thermal rating when measured by the "Hot Plate" test, but they rate very much lower if measured for air infiltration or transfer of heat by convection, and likewise would perhaps be lower in actual insulating value against heat moving by radiation, even when ½ inch or more in thickness, than the metal coated type of paper known as "Metallation" which is only some 95/1000 of an inch thick. But, owing to its highly polished aluminum surface, it is claimed to have an insulating efficiency equal to 20 inches of concrete, ¾ inch of cork, 2½ inches of wood, or 8/10 inches of an insulating board of average construction.

A third point in measuring heat travel is the resistance to moisture absorption. The "Hot Plate" test of an insulating board will show a tremendous difference if the material has absorbed considerable moisture. Water transmits heat readily, and if the cells in the insulating material, instead of being dead air spaces, are filled with water which has been absorbed, then the insulating value is greatly decreased.

To choose an insulating material wisely, therefore, we should know its efficiency in preventing heat travel by conduction, convection, radiation, and also its resistance to air infiltration, and its resistance to moisture absorption.

The factor of weight of the material should also be considered when making a selection. If the floor spans are rather long or the framing or wall construction otherwise unable to support a heavy load, it would, of course, be most unwise to select a heavy insulating material. However, insulating materials which have greater weight will usually heat up more slowly than light weight ones, and consequently the interior of the building will remain cooler during the hot days, because the heat penetrates the insulation more slowly. How much weight to give each of these factors is an individual question which, of course, will vary with the building to be insulated.

One of the most talked of types of insulation is the dead air space. Actually there are very few dead air spaces in any ordinary wall construction. Air spaces must be air-tight to be of any material value for insulation. It is seldom that the outside sheathing of a house or other building is air-tight, and consequently there is usually little or no noticeable difference whether the laying house is built with the insula-

tion board on the inside of the studding, leaving a 3⅝ inch space, or thereabouts, between the insulation board and the outside sheathing, or whether the insulation board is put on the outside of the studs, then building paper placed over that and sheathing on top of that. The difference in practical results, however, is very noticeable, for by the latter construction it is possible to get away from the pocket between the walls which forms an ideal home for rats and mice.

Another method of getting away from the rat and mouse difficulty where insulation is used on the inside of the studding is to fill the space with glass or rock wool, as rats and mice will not work through this material. Dry sawdust is also sometimes used as rats and mice dislike to work in that on account of the danger of suffocation. Shavings are not quite so good in that respect unless the shavings are very fine.

If a dead air space is depended on for insulation, it usually is much better business to see that it is filled with some good insulating material rather than to try to make it air-tight. Air-tight construction is highly expensive.

In sections where local lumber is obtainable, the best insulation is often provided by dry sawdust or shavings used in double-wall construction. Frequently, sawdust can be obtained from nearby sawmills, or shavings from a planing mill. Recently, the same type of insulation has been used with sheet metal interior and exterior. This has made a very satisfactory construction and is growing rapidly in popularity, being rat-and-mouse-proof and having long life with very little upkeep cost.

Cornstalk pulp is sometimes used as an insulator, and if it is dry when used and can be kept dry, it may be quite satisfactory. It has a relatively good insulating value.

Cinders are sometimes used as a filling in double-walled construction, and in Cornell bulletin No. 286, this is given a rating of 1.25, or about the same as 2-inch furring tile. Under practical conditions, it is likely that cinders and sawdust would be about equal in insulating value, and either one could vary considerably depending on relative fineness and other factors affecting the relative size and number of air spaces. Cinders certainly have an advantage from the standpoint of being more nearly rat-proof than any other common materials available at low cost.

Some litters, especially Peat Moss, Stazdry, and Sugar-Cane litter are good insulators and may be used instead of sawdust or shavings. However, they also

absorb moisture readily and in large amounts, hence care must be taken to have at least the outside wall thoroughly tight and water-proof if such materials are to be used as fillers.

Insulating boards have come into wide-spread use. They are reasonable in cost and extremely easy to apply. When insulating board first began to be used in poultry houses it was used in ½" or $\frac{7}{16}$", or some such thickness. *Practically all manufacturers of insulating board now recommend that material a full inch in thickness,* or approximately that, *be used* instead of the thinner board. *Most of the well known insulating boards have a very high rating as insulators.* There are small differences between various makes, but in most cases these are not of serious practical significance for the poultryman. The main thing is to get a good, standard, well made insulating board and use it in a thickness of approximately one inch.

Insulating board has one disadvantage that may be serious if it is not properly used. Rats and mice play havoc with it, and chickens will pick holes through most types wherever they have an opportunity. Construction of the wall must be such that it is rat-proof. Hardware cloth, Glass Wool, Rock Wool, or some other rat-proof material may be used at the base of the wall, or sheet metal or similar construction used to rat-proof the building.

Some method of rat-proofing must be used if insulating board is to be used on the inside of the studding. We believe that the most practical way for most poultrymen is to put the insulating board on the outside of the studding, cover it with a good waterproof building paper and then nail the sheathing on over that.

If insulating board is to be used on the inside of the studs, then we believe that the approximately 4-inch space between the inner and outer sheathing should be filled with a good insulating material, preferably Rock Wool or Glass Wool, from a standpoint of both insulating value and being rat-proof. Costs may be lowered by using sawdust or shavings, with increased danger from rats particularly where shavings are used, and in the case of sawdust some danger of warping and bulging of the interior sheathing of insulation board after the material has settled.

Insulating boards may now be purchased with hard finished surfaces which are more or less rat-resistant, and resistant to picking by the birds. Probably the most effective method of making the insulating board pick-proof is to cover it with a light grade of sheet metal up to a height beyond any point the birds can reach. Ordinary wire fly-screening can

be used in exactly the same way, and is very satisfactory, and somewhat lower in cost than the galvanized sheets, but has the disadvantage of collecting dust which the sheet metal does not. Hard, thin, sheets of "Presdwood" board are also used to protect the softer material in the same way.

Rock Wool, Glass Wool, and certain other "Wools" are now widely used for insulating residences and other buildings, and have been put to limited use in poultry houses. *Unquestionably, one of the most satisfactory poultry houses that could possibly be constructed might be made by using a double-wall construction incorporating a layer of polished aluminum foil insulating material, an inch of good insulating board, and the space between the walls filled with one of the standard insulating "Wools."*

Fire insurance rates and fire danger should be kept in mind. Remember that mineral materials like Rock Wool and Glass Wool are excellent from a fireproofing standpoint, whereas shavings makes a fine fire. Some insulating boards are fire-resistant and some burn furiously. It is a good thing to get your fire insurance agents' rates on construction of various types before you make a final decision as to construction details.

Saves Time

A young farmer in Reno County, Kansas, put an air horn on his tractor so he could signal his wife that he was starting on his last round before leaving the field for meals. Neighbors liked the idea, and one farmer, it is reported, has worked out a code whereby he is able to call for fuel, water, and other requirements as needed.

The Furrow

Reviewing New Varieties of Tree Fruits

Condensed from The Rural New-Yorker

H. B. Tukey

THERE was a time when one could make at least a half-way pretense of knowing the newer varieties of fruits. That was back in the post-war days when "standardization" was the watchword and when the recommendations from all sides called for elimination of the odd sorts and the centering upon a few. Today the new varieties are coming by twos, threes, tens and dozens at a rate that fairly makes the fruit world spin.

For the present the best advice one can give is to hold tight, be critical, and refuse to be swept away by contagious enthusiasm. The Hanska plum was developed in South Dakota where hardiness is the important factor. It cannot compete with the high-quality plums which can be grown in favored plum sections of the East. The Golden Jubilee peach is a splendid new early-season variety, originated in New Jersey. Today it is being planted by the thousands in places where it has not yet been given a thorough trial, and where those who pretend to know say it is destined to fail.

In short, it is well to be alert and to keep informed upon the new varieties, and at the same time it is well to be conservative and cautious in venturing into commercial plantings of the newer kinds.

To begin with apples in their season of ripening; Crimson Beauty, an old red variety of Nova Scotia origin, has been brought back to attention by those interested in the roadside stand. The fruit ripens a little ahead of Red Astrachan, and although the season is short, the fruits are large and well colored, and the tree is inclined to regular bearing. Lodi, the product of a cross between Montgomery and Yellow Transparent, is a splendid new acquisition because of a tree that is more vigorous than Yellow Transparent and fruit that is symmetrical, attractive, clear yellow and larger—although if extreme earliness is needed, Yellow Transparent is preferable, since it ripens several days earlier.

Next begins the procession of McIntosh-type varieties, led by Melba, a McIntosh seedling from Canada, which is recommended by fruit with a most attractive coloring of bright crimson over

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pale yellow and by good size and quality. Its season, however, like most early apples, is short, and the fruit is very subject to bruising.

Early McIntosh, which follows Melba, is a cross between Yellow Transparent and McIntosh. In white flesh and trim, uniform shape and color of fruit, it resembles McIntosh. In a tendency to biennial bearing unless thinned severely, the tree suggests Yellow Transparent, while the sturdiness and vigor of the tree more nearly resembles McIntosh.

Milton, the season of Wealthy, is a most attractive large, though unsymmetrical, oblong pinkish red apple with heavy bloom. The flesh is white and crisp, and the quality is very good. The tree is vigorous, the foliage is free from cedar rust that causes trouble with Wealthy in southern latitudes, and all in all the variety has found favor where an apple the season of Wealthy is desired.

Just ahead of McIntosh in season of ripening comes another Canadian variety, Lobo, which has had admirers in the sections just south of the McIntosh belt. The fruit hangs to the tree better than McIntosh, and is large, dark red, with conspicuous dots. McIntosh may itself be mentioned in passing, mostly to call attention to the tendency to insist upon high colored, solid red strains of this variety. If an Autumn sweet apple is wanted, Sweet McIntosh, with flat, dull red, white-fleshed fruits, will satisfy.

Cortland, which immediately follows McIntosh, is no longer a "new" variety. It has won a place for itself in commercial plantings and is being thought of more and more in terms of a variety to take the place of Baldwin.

Macoun and Kendall round out the season of McIntosh-type fruits. The former has fruits similar to those of McIntosh, but darker red and somewhat flatter and extending the season of Cortland several weeks. The tree is vigorous, but requires thinning. Kendall is recommended by fruit of trim contour and attractive glossy dark red color, which keeps a little longer than McIntosh. Indications to date are that it is an annual bearer, but only time will tell the full story.

There are other new apples. Among them, the large dark and red-colored Carlton, ripening a month after Red Astrachan; the Red Duchess, a more highly colored red sport of Duchess; the Red Gravenstein, a more highly colored red sport of Gravenstein; Newtosh, a McIntosh seedling of high color in season with Jonathan; and Lawfam, another McIntosh seedling, ripening two weeks earlier than Newtosh.

The host of red bud sports of Delicious can also be called new. Of these, Starking and Richard

are both improvements where color is an important consideration. Orleans and Medina, two crosses between Deacon Jones and Delicious, were introduced because of larger fruit than Delicious, which they resemble. Reports vary as to their performance and they should still be kept on the "on trial" list. Finally, if a fine sweet Winter apple is needed, Sweet Delicious is heralded as the best available today.

New pears do not present quite so formidable an array. First come Early Seckel, Cayuga and Clyde, all seedlings of Seckel, and all having the characteristic flavor and high quality of the parent. Early Seckel ripens two to three weeks ahead of Seckel and keeps well in storage. Cayuga and Clyde are both larger than Seckel and extend the season. Unfortunately the tree of Cayuga is late in coming into bearing.

The Bartlett types include Gorham, Ewart, Pulteney, Phelps, Ovid and Willard. All are on trial excepting Gorham, which ripens two weeks after Bartlett, thus extending the season, and which has been recommended for planting by growers in California, Ohio, Michigan and Eastern States. Ewart is from Ohio, characterized by fruit larger than Bartlett and four weeks later than Bartlett. Pulteney ripens a month after Bartlett but the color is not all that one should like. Phelps ripens the end of November, but again poor color is a handicap. Ovid ripens in December, is large, has color resembling Bartlett, but with russet patches, and altogether promising. Willard comes two weeks after Ovid, resembling Bartlett in size, shape, color and quality.

Peaches are experiencing one of those several changes in the varietal list which comes every generation. The list of new yellow varieties starts with Marigold, ripening five days after Mikado, nearly freestone. A bud sport of Valiant, named Fisher, is arousing considerable enthusiasm in Canada where it was discovered, since it ripens about with Marigold and is said to be larger in fruit. Oriole ripens a week later and has good size and quality, although a trifle dull in color. Golden Jubilee follows a week later and a week ahead of Rochester, and is by present standards, the finest of the new sorts. In shape it resembles Elberta, but the quality is far superior. Its most serious fault for large-scale commercial planting is that the flesh softens rapidly. Then come the "four Vs'" of Canadian origin, Vedette, Valiant, Viceroy and Veteran, ripening in the order named, the earliest being two weeks ahead of Elberta and the last a week to 10 days before Elberta. To date

Valiant and Veteran are attracting most attention, the latter being recommended to replace Early Crawford.

Halehaven, a product from Michigan, has pushed rapidly to the front since its introduction a few years ago. It ripens about with South Haven, and a few days after Valiant and is recommended by fine size, attractive color, and good quality plus a vigorous, hardy tree. South Haven is suffering from the competition from this variety. Still another variety of merit is Fertile Hale, a self-fruitful type of the J. H. Hale. And now from New Jersey come two more, Golden Globe (No. 73) and Goldeneast (No. 87). The former is similar in fruit shape to J. H. Hale and ripens slightly later than Golden Jubilee, while Goldeneast comes 10 days after Golden Jubilee.

Interest in plums is away from the Japanese types, excepting for early trade on roadside stands, and towards the prune types. Most of the varieties now being discussed for planting are not new, but are revivals from the old list. Among these is Pacific, a large blue freestone plum of excellent quality, which boasts in addition a vigorous, productive tree. For the fresh fruit trade it is a splendid sort. Then there is Imperial Epineuse, an old French variety which requires cross-pollination and the fruit of which is not overly attractive, yet whose quality and flavor is in the opinion of many, including the writer, about as fine as can be found in the plum group.

Of the really new ones, there are three which command most attention—Stanley, Hall and Albion. The first is a medium-sized blue, prune shape fruit, attractive in appearance and high in quality, ripening 10 days ahead of Italian Prune. The trees are vigorous and inclined to load heavily—perhaps too heavily. Hall and Albion ripen the last of September. They are of the Grand Duke type, very large, attractive and good in quality. Their lateness in maturity is their chief handicap.

Again, as in the case of the plums, it is many of the older varieties of sweet cherries which are coming back into the class of "new." Among these are Early Rivers, Lyons, Emperor Francis and Hedelfingen—all old European kinds. Early Rivers is widely grown in England for its crimson-black, firm flesh fruit, ripening 10 days before Black Tartarian. Lyons has very large, dark, firm, high-quality fruit, ripening a few days before Black Tartarian. Emperor Francis is a large, white variety similar to Napoleon, but ripening two or three days earlier and less subject to cracking. Hedelfingen ripens

shortly after Windsor and is recommended in place of Lambert which cracks so badly under eastern conditions.

Another group of less antiquity, but still not young in point of origin, are Giant and Abundance. The former ripens just before Lambert, cracks less, and has large, purplish-black fruit. Abundance is a very late white sort of the Napoleon type. Victor may be mentioned as the only really new variety with the possible exception of Seneca which was introduced several years ago. Seneca is the earliest good sweet cherry, either so good or so early that the birds have a way of disposing of much of the crop! It ripens two weeks ahead of Black Tartarian and is red in color. Victor comes from Canada, introduced as a Napoleon type, ripening midway between Governor Wood and Napoleon.

The sour cherry defies improvement over the standard Montmorency; the nectarine is represented in a trial way by John Rivers, Rivers Orange and Sure Crop, ripening in the order named, and the apricots find only the Geneva and the Henderson as champions among the newer kinds.

How Milk Increases Turkey Profits

Condensed from Turkey World

Dr. A. T. Ringrose
University of Kentucky

THE use of milk by-products in one form or another in growing and laying rations for chickens is a very common practice. Likewise, the incorporation of milk in some form into the turkey ration is not entirely new with many turkey feeders, and this practice is becoming more and more popular.

It is only in very recent years that the science of nutrition has given us some definite proofs for the value of milk feeding. Studies on the quality of protein have shown that not all protein concentrates have the same feeding value. We have learned that one type of protein, that is, those arising from a vegetable source such as corn, wheat and the like, are not satisfactory for poultry and turkeys when fed as the only protein source. We do know, however, that these vegetable proteins are very satisfactory when properly supplemented by suitable protein concentrates originating from animal sources such as milk. Careful studies of

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the chemical nature of proteins have revealed that each protein is "built up" of individual constitutents called amino acids. Different proteins may contain different amino acids. Studies of these individual amino acids have shown that at least 10 of the 22 different ones must be supplied in the feed for life and growth. These amino acids are required for the formation of body tissue, principally the muscles. When they are lacking little growth occurs and mortality is often high. When the turkey consumes protein, therefore, it is getting amino acids in order to form the protein of its muscles on the legs, the breast and other parts of its body, as well as for the formation of eggs during the laying-breeding season.

The proteins of milk are two in number and both of these are well supplied with the more important amino acids, particularly those amino acids which are lacking from the proteins of cereal grains. These scientific facts have a very practical application to the building or compounding of rations for feeding turkeys.

We should also give serious consideration to other constituents of milk, since these are even more important. These other important constituents are the vitamins. Here again, the science of nutrition has brought forth many new and interesting facts in recent years.

In these fundamental studies, the first water-soluble vitamin discovered in milk came to be called vitamin G, since letters of the alphabet were being used to name other vitamins. Much of this experimental work with chicks was conducted at the New York State Agricultural Experiment Station at Cornell University and at the Ohio, Wisconsin and California Stations. The work at the Cornell Station showed that the vitamin present in milk in the largest quantity was vitamin G. However, it was not long before the work at Cornell and other stations indicated that vitamin G was not a single vitamin, but that it consisted of at least two and possibly more than two vitamins. We, therefore, must consider vitamin G as a complex composed of two or more than two vitamins. One of these vitamins of the vitamin G complex was shown to be very strongly growth-promoting and more recently to be preventive of a peculiar paralysis of the legs and toes of chicks. This one is still called vitamin G and has also been proven to be required in order to promote growth in turkeys. The other vitamin of the vitamin G complex was shown to be necessary for the prevention of a pellagra-like ailment of the skin of chicks. This is called by

some investigators the anti-pellagric vitamin, and by others, the "filtrate" factor. A pellagra-like ailment of the skin has also been noted in young turkey poults, when milk or other feed ingredients containing this vitamin are absent from their ration.

We see then that both growth promoting vitamin G and anti-pellagric vitamin or "filtrate" factor are equally as important for growing turkeys as for growing chicks.

The most recent discovery concerning growth-promoting vitamin G of milk has been the determination of its chemical nature, and the fact that it possesses a very characteristic yellow-green color which strongly fluoresces in daylight, even when very small amounts are present in a solution of water. In addition to being called growth-promoting vitamin G, this material has also been named flavin because of its chemical nature, and since it was first discovered in milk it is called lactoflavin.

Considerable work has been done at the Cornell and Ohio Stations which shows that vitamin G is required for the production of eggs that will hatch well. This is a very logical outcome since vitamin G is strongly growth-promoting, and the hatchability of a fertile egg is determined by the growth of an embryo within the egg shell. We see, therefore, that milk is a valuable feed for use in the turkey breeder mash as a source of vitamin G in order to promote hatchability.

There are many forms of milk by-products which are available for use in turkey feeding. Liquid skimmilk may be fed in place of water to drink. Milk may be fed as a liquid, as a dried white powder for incorporation into the mash mixture, such as dried skimmilk, dried whey and dried buttermilk, or it may be fed in a semi-dried condition such as semi-solid buttermilk, or condensed buttermilk for use in preparing wet mashes or for feeding by hand daily on top of the dry mash hoppers. On a dry matter or milk solids basis, all of these forms are practically of equal value for turkey feeding, when both protein and vitamin content are considered. Many turkey feeders obtain satisfactory results by using one of the dried forms, while many others obtain equally satisfactory results by using one of the semi-dried forms. Condensed buttermilk and dried buttermilk are also available with specially processed green grass added which supplies additional vitamins.

The proteins of milk products are of extremely high quality and are different from the proteins found in other animal supplements such as meat scrap and fish meal. Since this is true, and

since milk products also supply the vitamin complex which is so necessary to promote growth and hatchability and to prevent leg paralysis, milk products should be used in turkey rations in addition to meat scrap, fish meal, and other protein supplements.

When liquid skimmilk is the only source of milk fed, it should be given to the birds in place of water to drink, and the birds should be encouraged to consume as much as possible by withholding water from them. Liquid skimmilk may be fed either sweet or sour.

When one of these milk by-products is to be used in the dry mash, at least 5 percent should be added for growing stock or for breeders. For starting poults in confinement, or when the birds are to be reared in confinement or semi-confinement, or when the breeders are confined, this amount should be increased to 10 percent or more. As the milk concentrates on the market vary somewhat in their protein and vitamin content, the recommendations of the manufacturer should be followed in order to get best results.

In-Breeding

Condensed from The Duroc News

Dr. O. P. Bennett

INBREEDING, in the scientific sense of the word, means the mating of any two related individuals, no matter how remote the relationship. However, practical breeders usually restrict the word inbreeding to the mating of brother to sister or of parent to offspring, and many of our best authorities now define inbreeding as the mating of two animals which have at least 50 percent of like ancestry. However, this does not necessarily mean descent from the same animal as a parent or even of a grandparent. These same authorities define line breeding as the mating of individuals with not less than 25 percent and not over 50 percent of similar ancestry, but with a succession of sires that trace to the same individual. The principle involved in both inbreeding and line breeding is the same and the difference that of degree only.

There have been few subjects connected with breeding that have caused such acrid discussion as inbreeding. Much has been said in its favor, much

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against its use. There have been many laboratory experiments conducted to prove the harm or the harmlessness of it. Castle and his students, with the small fly, Drosophila, bred together brother and sister for fifty-nine generations in succession, without any apparent diminution in either vigor or fecundity. However, he also found that the crossing of two of these inbred strains or families produced offspring superior in productiveness to either of the inbred strains. Bos, commencing in 1894, carried on inbreeding for six years with a family of rats, which showed no bad results for the first half of the experiment but showed rapid decline in both vigor and fertility later. Weissmann's experiments with mice confirmed the results obtained by Bos. More recently Dr. Helen King has inbred rats for more than 50 generations, mating brother to sister and found that if the more vigorous were selected as parents, rats of large size, vigorous and of complete fertility may be maintained under the closest of inbreeding. Dr. Sewall Wright of the Bureau of Animal Industry has inbred guinea pigs brother to sister for more than 25 generations and found that some lines showed many defects or even died out entirely but other lines maintained or even increased their size and vigor. On the average, he found a slight decline in size and vigor and that each line became remarkably uniform for many characters; i. e., that its type became "fixed."

The great objective of inbreeding is the fixation of hereditary qualities. This is of great value in emphasizing those qualities which are desirable, but it must be borne in mind, that the undesirable ones are just as easily and firmly fixed. It should be quite easy to understand just why this is so, when we recall that by inbreeding we are simply bringing together animals whose hereditary material is more uniform and whose characters are more nearly alike, than we do when we mate those not related. In consanguineous breeding, the mated animals, having the same ancestry, would and do have many of the family characteristics in common. These characteristics, shared in common by both parents, are also transmitted by both parents to their offspring, hence, in this way become intensified and strengthened by the augmenting power of the two similar hereditary forces.

It should always be remembered that inbreeding has no creative power, and by its use we only intensify existing characters, both good and bad. In other words it is of benefit to the breeder in that it enables us to accumulate the hereditary mate-

rial of a superior animal in the founding of a family of his breed. The greater the percentage of this material assembled in his descendants, the more the offspring will resemble their sire and the more they will resemble each other, and the more likely they will be to further transmit this material to their offspring. In this way the characters with each succeeding generation become more firmly fixed.

In practically every breed of animals, inbreeding has been resorted to by the earlier breeders, at least, to assure that fixity of type which entitles a class of animals to be called a breed, and, when this has once been established, to fix the type of the families within that breed. It should be clearly understood, however, that one reason earlier breeders resorted to its use was their inability to secure elsewhere males or females equal in quality to those in their own herd and that inbreeding was followed, perhaps largely because they did not wish to introduce into their herd hereditary qualities that were inferior.

It would be difficult indeed to overestimate the great benefit breeders of various kinds of livestock have derived from very close breeding.

The more closely an animal is inbred the more nearly his hereditary characteristics or units become homozygous, which results in animals whose reproductive cells so far as hereditary characters go are of one kind, as the tendency is for the heterozygous to be automatically displaced by the homozygous. The closer the degree of inbreeding the stronger is this tendency. Inbreeding by this very tendency to secure homozygous characters often brings to the surface latent or recessive characters.

It is quite generally believed by all breeders, and rightly so, that sires whose ancestors are of the same line of breeding, who are therefore somewhat closely related, are much more prepotent than sires whose parents are of dissimilar ancestry.

There are four forms of inbreeding possible among animals if we accept the descriptions of the terms as given previously:

(1). The mating of a sire to his best daughter or daughters. This is used when the sire is such an exceptional individual that it is desired to secure as great a percentage of his blood as possible and if followed up, even for a few generations, will result in animals of but one line of ancestry—that of the sire. The offspring even from the first mating contains three-fourths of the blood lines of the sire, that of the second containing eighty-seven and one-half percent. It is a well-known fact however, that a sire

can be bred successively to his daughter, granddaughter and great granddaughter without his type becoming fixed unless it is fixed in himself.

(2). The mating of a female to her best son, thereby increasing the bloodlines of the dam. This is used when the female possesses exceptional merit and it is desirable to preserve and condense her blood lines.

(3). The mating of brother to sister in which the blood line of the sire and dam are present in equal proportions. This should be used only when the previous mating has been unusually successful, the offspring being superior in quality to both sire and dam, and it is desirable to preserve the high quality of the two mated. Since in this type of mating, the bloodlines of both sire and dam are being strongly concentrated, at the same time the chances for new hereditary combinations both good and bad are very greatly increased. This is the most extreme type of inbreeding possible with animals and its results are also the most extreme and the least accurately to be predicted. The breeder who undertakes it need hardly expect uniformity in the results.

(4). Any mating other than the above in which there is at least fifty percent of the blood of the same ancestry.

In the case of mating sire to daughter or in the mating dam to her son, the system or plan is necessarily limited to the life time of the individuals involved, but if it has been successful and it is desired to carry it on further, it may be done by the use of grandsons and granddaughters.

The mating of brother and sister is not considered as good a plan as the other three and is attended with considerably more danger as we have no means of knowing, previous to the birth of the young, just what the combination will bring forth, while in the other methods in which we endeavor to strengthen one line of ancestry over another, whether it be sire or dam, we deal with blood lines we know to be in accord with each other. In the mating in which there is at least fifty percent of the same blood but not necessarily of the same animals, we have a much greater number of animals to select from than in the three previous matings, but it is by no means certain that full brother or sister may have the same identical characteristics due to the variety of possible combinations of chromosomes.

If all animals were of exceptionally high quality and not foreign in blood lines, there would be little, if any, necessity for inbreeding. Due to the fact that we have in all breeds a large number of mediocre quality and

very, very few of outstanding merit, we are able by this method to make the most of their excellence and to secure the highest percentage of the blood of those exceptionals in their offspring. In the same manner, a particularly fortunate mating or "nick" can be preserved and their desirable characters be made characteristic of all of the inmates of an establishment.

This method has not been used as much to originate excellence as to preserve it when once it has appeared. There is no other known method of breeding to compare with it for intensifying blood lines, for preserving existing combinations, and for getting the most out of exceptional individuals, especially if their ancestry all be of high quality.

It should be clearly understood that if inbreeding enables us to preserve and intensify good qualities it will act just as readily in preserving and intensifying the undesirable, as it may affect all characters alike.

Strains of Legume Bacteria

Condensed from The Indiana Farmer's Guide

DURING the past 50 years scientific investigations have added much to our knowledge of the legume bacteria and their unique association with leguminous plants. The more we learn about this interesting group of soil microorganisms, the easier it is to understand the reasons for many legume crop failures in the past.

The scientific practice of inoculating legumes with reliable commercial cultures provides the ways and means to help prevent such failures, and at the same time enables farmers to secure double profits from legume crops through increased yields of higher quality, plus a more permanent soil improvement program.

The very earliest investigations proved the existence of different kinds of legume bacteria. This fact eventually led to the establishment of definite groups of legume bacteria, the bacteria within a single group being capable of producing nodules on any legume plant belonging to its corresponding group, but not having the ability to inoculate legume plants successfully in any other group. Thus we have the alfalfa, sweet clover and burr clover group; the red clover or Trifolium group; the pea and vetch group; the cowpea group; the

Reprinted by permission from Indiana Farmer's Guide, Huntington, Indiana, April 9, 1938

soybean group; and several others of less importance. These groups are known as cross-inoculation groups, because the bacteria isolated from any single legume plant in a certain group will inoculate all the legumes in that same group.

The cowpea group contains by far the largest membership. In contrast is the soybean group; the soybean bacteria will associate only with the soybean plant. A legume was said to be inoculated if nodules were found on its roots. And when inoculating legumes with commercial or artificial cultures results were measured by nodules alone rather than by the effect on growth or the amount of nitrogen found in the plants.

Only within recent years have workers attempted to measure different degrees of inoculation—to study the number, size and location of nodules on the root system, and to analyze chemically both inoculated and uninoculated legume plants grown under the same conditions to determine how much nitrogen is really taken from the air by the legume bacteria. Studies like these have revealed the existence in nature of different strains of legume bacteria.

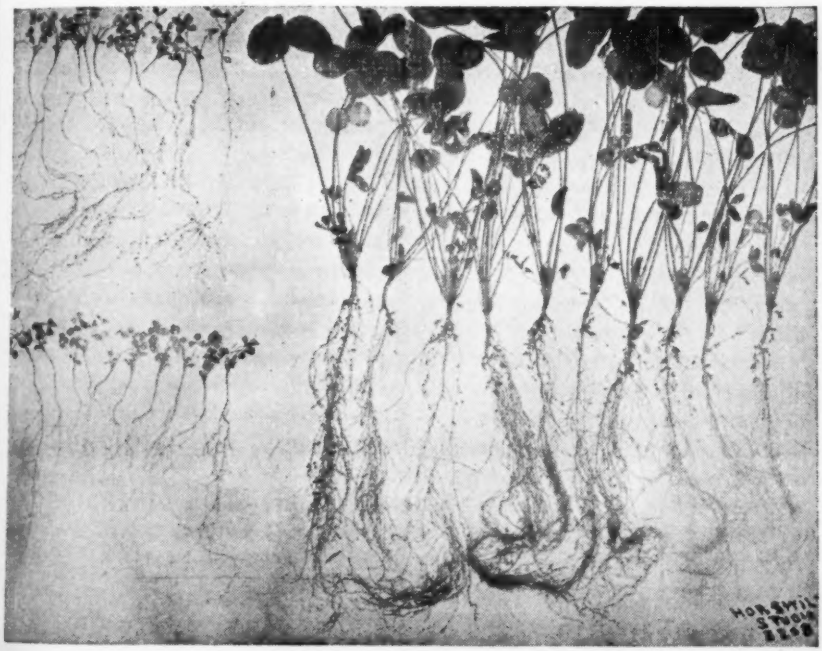
Strains of legume bacteria are now recognized in much the same manner as farmers recognize different strains of chickens, live stock and farm crops. Various strains of legume bacteria belonging to a given group, for example, the alfalfa and sweet clover group, are far from having the same ability to form nodules and to aid the growth of alfalfa and sweet clover. Some strains may be highly effective, others intermediate, and some may be very poor in their ability to aid the legume. Strains of legume bacteria that form nodules but do not have the ability to utilize air-nitrogen have been found widely distributed in nature. Such strains are called ineffective or parasitic strains of legume bacteria.

It is a fairly easy matter for the soil bacteriologist to test the effectiveness of different strains of legume bacteria. Individual strains are used for inoculating seedlings, the seeds of which are previously sterilized to free them of any legume bacteria that may be carried on the seed coats. The plants are grown in sterilized, nitrogen-free sand under controlled conditions in the greenhouse. They are watered with a nutrient solution containing all of the essential plant-food elements for plant growth except nitrogen. When the reserve supply of nitrogen stored in the seeds is exhausted, additional nitrogen, so necessary for satisfactory growth, must come from the air by action of the bacteria. At the

end of the growing period the entire plants, tops and roots, are analyzed for total nitrogen. The difference in nitrogen found between the inoculated and uninoculated plants represents the gain in nitrogen or the amount of nitrogen actually taken from the air by the various strains of legume bacteria.

Naturally the plants showing the highest nitrogen content are produced by the most efficient strains of bacteria. Where a number of strains are used in such a test all gradations from the highest nitrogen-fixers down to the lowest nitrogen-fixers are usually found. A selection of the very best strains is thereby made possible. Naturally enough, these highly effective strains of legume bacteria show the same superiority over natural or chance inoculation as do pedigreed seeds over wild plants, or pure breeds over scrub livestock.

The accompanying picture shows three sets (10 each) red clover plants. All of the plants were grown under identical conditions for the same length of time, the only difference being the strains of bacteria used for inoculation. The plants in one group received no legume bacteria whatsoever, and of course, produced no nodules. Those in



another group were inoculated with a strain of red clover bacteria, that in all outward appearances looked good, but proved to be definitely parasitic. Numerous small nodules were formed all over the roots but the bacteria in these nodules were not able to aid the plant. Other plants were inoculated with a highly effective strain of red clover bacteria. The benefit to the plant was reflected in the size and vigor of the plants and the analyses showed that these plants actually contained over 50 times as much protein as did the uninoculated plants.

Similar tests have been made on alfalfa plants, burr clover, and other legumes. Similar results were obtained in each case. Altogether they prove the striking difference in the strains of legume bacteria and the dependence of the plant upon the presence of the right kind of organism.

Under actual field conditions, differences between inoculated and uninoculated plants usually are not so marked as those obtained in sand cultures in the greenhouse. Most soils contain sufficient available nitrogen to make a fair plant growth without inoculation. But in such cases the legume crop will draw upon the soil nitrogen, and there will be a decided reduction in soil fertility rather than the marked soil improvement.

It Doesn't Pay To Puddle

Condensed from Pacific Rural Press

John E. Pickett

THE man in the furrow, breathing deeply of the smell of mellow earth, feeling its granular friability under his feet, knows the value of good tilth.

He knows that seeds smile and plants laugh in that sort of pleasant home.

He also knows that tight soils, particularly those which have been puddled by working them too wet, do not produce happy plants.

But there are new things we are learning about why puddle soils produce unhappy plants, and what we must do about it.

Prof. W. T. McGeorge, head of the chemistry and soils division of the University of Arizona, is one of the inquiring scientists who has been probing farther into soil structure. He and Prof. James F. Breazeale, biochemist, have been making excursions in fact finding which have charted interesting pathways.

Reprinted by permission from the Pacific Rural Press, March 12, 1938

They were drawn into some side trips of discovery when making some tests of fertilizers. They have found in the past that nitrogen and phosphorus fertilizers give fine responses to crops in their irrigated valleys, but they discovered that the results which they obtained when they tried fertilizers in flower pots, did not always correspond with results in the field. That led to the thought that perhaps the condition of the soil had a good deal to do with it.

The usual practice when you try out fertilizers in pots, is to take some good soil, well pulverized and in good tilth. Fields may not be in good tilth. Frequently in irrigated districts lands have a puddled condition. They do not have that granular structure which gives the soil its breath, so to say, and permits the free action of soil bacteria, and holds water so the roots can get it most readily.

So they conducted experiments, which proved that plants don't do as well in puddled soils as they do in the soil of good tilth, and you don't get as much for your fertilizer investments when you use puddled soils.

But that is not all of the story. Every informed farmer can understand why nitrifying bacteria do not work as well in a puddled soil. They don't have the "elbow room," so to say. They don't have the air, and the soil warmth, and the conditions which are favorable. So the soil does not have so much nitrogen made available. That is very understandable. But the interesting fact which is not so well understood, is the fact that the puddled soil actually "squeezes" out some of the nitrogen which was there, and you lose it in the form of gases given off into the air. Thus while you are having less nitrification in puddled soils you are also having denitrification, to add to the soil poverty.

They have found that in these puddled soil conditions ammonium sulphate appears to be denitrified to a greater extent than sodium nitrate, and they conclude that this may have some bearing on the relative value of these fertilizers on poorly drained soils.

Professor McGeorge is an interesting and alert beagle for facts, and we asked him what was to be done about applying these discoveries.

The first thing, of course, is not to puddle your soils by working them, or running over them, when they are too wet. Puddled soils are hard to irrigate, and you lose yields of crops, and lose fertility.

But if soils are puddled, as many soils are in western irrigation areas, he has some practical suggestions.

If the soil is being cropped annually, one way is to let it lie fallow and get thoroughly dry. Nature will re-group the soil particles to give it better tilth.

If it is land which is cropped to perennials, where the drying out process cannot be resorted to, he suggests dust mulches on the top to improve the condition of soil below.

The right amount of irrigation, and not too much irrigation, and avoiding waterlogging is a practical method.

We have known this a long time, but a good many farmers do not use soil augers, or dig down to find the right time to irrigate, and many do not have the courage to wait for the approach of the wilting point of vegetation. There is still too much shotgun prescription on the theory that if a little water is good, a lot will be better. That is expensive in many ways. It takes too much water, too much labor, and produces too little growth.

Some have been saved from the full consequences of such a policy by soils so sandy that it is hard to puddle them, but not many farmers can rely on this protection.

Cover crops and the addition of humus to the soil are obvious means of improving the tilth and the productivity of soils.

In view of some of this newer knowledge, we will surely find a swing back toward subsoiling, and toward giving soils drying out periods, when Nature will undo some of the irrigator's errors.

Observant farmers have always known that you get the best returns on your fertilizer when you put it on your best soils. This information regarding soil structure and its effects may teach us to get better returns out of some of our poorer soils by handling them better.

Eggs to Music

WITH a radio in continuous operation in the West Cornwall, Conn., laying house of W. E. Kugeman, the farm's 550 musical hens averaged 480 eggs daily but, when the radio broke down, egg production dropped to 380 eggs daily. A new radio brought the return of the 480 average.—*The Furrow*

Handling Hybrid Seed Corn

Condensed from The Ohio Farmer

L. L. Rummell

WHAT makes hybrid seed corn so expensive? Is it scarcity or is it superior productive capacity over ordinary sorts of corn? This might be ascribed as the reason, for hybrid seed has been in strong demand; and as compared with open-pollinated varieties, hybrids in Ohio for seven years have averaged 16 percent higher in yields, or nine bushels per acre more.

Yet this seed should command a relatively high price, in addition to superior yielding capacity, because of the care growers give it. Certified hybrid corn is the last word in quality—germination, purity, and truth in labeling.

These inbred lines to produce hybrid corn have originated largely at the agricultural experiment stations and United States Bureau of Plant Industry, and now these are being propagated by a few experienced, careful growers. In Ohio a co-operative organization, called the Ohio Hybrid Seed Corn Producers, produces inbred lines and single crosses for its members, who in turn grow the seed for sale.

A grower who wants to produce hybrid seed corn must have his plot well isolated from other corn. He must have a force of helpers to detassel at regular and timely intervals the "female" rows, one person for each three to five acres going through the field daily in the season when tassels are forming.

Then in the fall all the sound, healthy ears are saved from the detasseled rows; and this seed is placed in a storage house with artificial heat, so that the moisture content can be reduced to 14 percent and protection is thereby afforded against spread of rots and molds and against freezing.

Large commercial growers have separate seed houses where corn is stored in bins or racks with ample air circulation, and a furnace is used for drying. Three to five days at 105 degrees F. will dry the corn out satisfactorily, and then during the winter season it can be shelled, cleaned, graded and bagged.

The Ohio Seed Improvement Association sets up certain standards or requirements all growers must meet if they are to carry the "certified" label. They pro-

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vide inspectors who visit the farm several times during the growing season and at the storage to see that these regulations are being met.

It is because of these strict rules as to production, storage and marketing, that only a very few growers are qualified to produce hybrid corn for seed. Any farmer will do well to grow hybrid corn for grain because of its superior yield, but only a handful will practice the meticulous care for producing the seed.

After the corn is harvested and put into the seed house, let's follow it through the operations necessary to guarantee a given grade that some farmer buys:

Forced ventilation of warm air from a furnace, never over 110 degrees F., brings the moisture down to 14 percent in three to five days. Every ear from the "female" or detasseled rows has been saved, because every kernel has exactly the same heritage. Hybrids differ among themselves, and the same hybrid will vary in appearance on different farms depending on growing conditions. Moldy, very small kernels or those injured by ear worm are rejected; and hence the first operation generally is tipping either by hand or by a shaft-type device. The better tip kernels may be held in reserve for sale in case of seed shortage. In a year like 1937 when corn generally was of such high quality, little or no tipping was necessary.

Next the ears are put through the sheller, and usually one man watches the ears individually to see that each looks perfect to the eye. All sound kernels are saved.

Cleaning is the next operation, and here the seed is put over a fanning mill to blow out chaff, cracked kernels, pieces of cob, light kernels, etc. In this operation the very small and very large kernels are sorted out.

Finally the seed is ready for the grader, and generally five grades are made, as follows:

1. First Run Medium Flats.
2. First Run Large Flats.
3. First Run Large Rounds.
4. Second Run Medium Flats.
5. Second Run Medium Rounds.

The Ohio Seed Improvement Association maintains a list of producers and distributors of seed corn hybrids adapted to the various sections of the state. It supervises crossing plots, inspecting them three to six times before and during the detasseling season and later at the storage, makes moisture and germination tests and checks grades for grower-members. "Certified" Hybrid seed corn is the hallmark of quality.

Preparing Rabbits for Market

Condensed from The Western Farm Life

Houle and Fry

IN the preparation of domestic rabbits for market there are two factors to consider—the meat and the fur. Since domestic rabbit fur becomes prime about every three months, it is best if the butchering is so scheduled as to carry it on at these times of prime fur condition.

Rabbit skins are divided into three grades: No. 1 or completely prime; No. 2 or nearly prime; No. 3 or hatters or unprime skins, also thin papery skins. These skins are bought according to the manner in which they grade, the first two grades being paid for by the individual skin and the hatter stock by the pound. It is, therefore, essential that the skins be prime so that the most money may be received for them. Some fur buyers allow another grade which is not prime enough to use as individual furs and too prime for hatter stock. These furs are usually paid for by the piece.

Skins are prime about every three months or immediately after molting. If the fur does not pull out easily, then the skin is prime as molting has ceased. When molting, the hutches are usually covered with the loose fur that has come out, so as soon as this stops the molt is complete. It is then time for butchering.

The method of killing rabbits used by the more successful breeders includes three steps. In taking the rabbit from the hutch to the killing plant, always grab it by the ears and never by the skin. If the rabbit is not thus handled there is danger of damaging the pelt and thereby lowering its value. Have the killing plant located away from the hutches.

When the rabbit is brought to the killing plant, handle as follows: Have on hand a small blunt instrument, such as a piece of pipe, or other round metal, or a piece of rounded hard wood, about 1 foot in length. Also have ready a sharp, pointed knife to be used for bleeding and skinning. Grasp the rabbit by the ears and hold it in an upright position with the front feet off the ground and the hind feet barely touching the ground, with the back of the rabbit toward operator. Now take this blunt instrument, held firmly in the free hand, and tap the rabbit soundly between the base of

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the ears and the highest vertebrae, allowing the rabbit to fall to the ground after being hit. If properly hit, the rabbit will stiffen at once and the legs will twitch steadily.

Drop the blunt instrument at once and pick up the knife in one hand, while with the other hand grasp the ears with the fingers, holding the thumb at the spot on which the rabbit was hit. Force the head back. Immediately insert the knife in front of the neckbone at the base of the jaw and slit forward, crossways with the neck, thus severing the jugular vein.

Drop the knife at once and with this hand grasp the hind legs (still holding the ears with the other hand) and immediately lift the body from the ground, head down, holding firmly so as not to allow the blood to get on the fur. Hold in this position until there is no more body movement and until the bleeding has almost stopped. These three steps must be done very quickly, in fact almost simultaneously.

Now that the rabbit has been killed and properly bled, the next operation is skinning. Hang the rabbit by the tendons of the hind legs upon two hooks or nails, these hooks or nails being far enough apart to allow the legs to be well stretched. The head should be cut off directly behind the ears, and the front feet cut off at the first joint. The tail should also be cut off as it has no special value.

Cut the skin around one of the hind legs, just below the first joint, continuing the cutting down inside the leg, across the center, under the tail, and up the inside of the other leg and around this leg at the point below the first joint. When this cut is completed, the skin can be pulled down over the body while at the same time a dull knife is used to cut away any loose flesh or fat that may adhere to the pelt. In this operation do not scrape the skin too closely and thereby damage it. Merely cut off the superfluous fat or flesh. The skin is now ready for stretching.

The next step is the removal of the entrails. With the under side, or belly, facing operator, a small bone will be noted midway between the two hind legs. Make a cut through this bone at a point immediately to one side of center, then make a similar cut on the other side. These cuts extend through only to the body cavity. Bring these two incisions together to a "V," continuing the cut down through the center of the belly to the breast bone. In making this cut place two fingers at the vertex of the "V," thus holding the entrails back while the incision is being made. With this cut completed, carefully remove the entrails, starting at the top, but

leaving the kidneys and kidney fat intact.

The opening being made, the stomach will fall forward hanging only to a tube that extends through the neck. By holding the liver in place, and at the same time pulling upward on this tube, these organs come out, leaving the liver attached to the carcass. Remove the gall from the liver.

The operator should cut the diaphragm and split the breast bone, continuing the cut down through the neck. Pull the lungs forward and cut loose from the heart, leaving the heart attached in place to the carcass. Remove the wind-pipe and cut off the hind legs at the first joint, and the dressing is completed.

To make a good impression and also to do a proper job, the kidneys, liver and heart are always left in place in the carcass, as these are used as are the giblets of a chicken. By leaving these organs in place, it is readily ascertained by the public that the rabbit was in perfect health and condition before butchering. For these reasons it is imperative that only healthy and vigorous stock be killed for market, and it is necessary that the animals be fat.

These operations now being completed the carcass is thoroughly washed in cold water. Be careful to remove all traces of blood. The entire operation, from the killing to the washing should require only 4 to 5 minutes. Go slowly at first and, with practice, gradually attain a satisfactory time limit.

With the washing completed, the carcass is placed in clean, cold water in which a good handful of salt has been dissolved. The carcass is left in this water for from 2 to 3 hours, at which time the fat should be solid and the meat firm and white. This soaking adds about 20 per cent to the weight of the carcass, besides making the meat more tender and of better flavor. After this soaking the carcass is allowed to hang for several hours to dry properly. The rabbit is now ready for market.

Fertilizers for Tobacco

Condensed from Eastern States Cooperator

P. J. Anderson

Agri. Exp. Sub-Station, Windsor, Conn.

THE fertilizer cost constitutes the major cash outlay and is the hardest one for the average tobacco grower to meet.

Many years of experimentation have convinced us that on the average tobacco soil type, the crop needs about 200 pounds of nitrogen and the same amount of potash. To add more than that is expensive waste and to apply less is folly—except that on certain strong soils the nitrogen may be reduced somewhat. Over 90 percent of our fields need no special carriers of phosphoric acid; a simple soil test will show whether they do or not. Thousands of dollars are wasted in the purchase of useless phosphoric acid. Magnesia is much more important in our tobacco formulas than phosphoric acid and it is the least expensive of the fertilizer elements. As a usual rule, the formula should contain 60 to 70 pounds to the acre of magnesia. Here again, however, the grower should be guided by a soil test or should judge by the ash color of his tobacco.

A greater economy, however, may be effected by a wise choice of the materials in which he supplies the essential food elements in his formula. To furnish any one of these elements he has a choice of several materials and by watching the market he may make a considerable saving by substituting a less expensive material for a more expensive one.

The greatest variety is furnished by the carrier materials of nitrogen. The organic materials as a class are much more expensive than the inorganic or mineral forms. To what extent can we substitute the mineral nitrogen forms for the more expensive organics? Among the cheapest mineral forms are the nitrates—nitrate of soda, nitrate of calcium and nitrate of potash. If it were not for the fact that the nitrates leach away so easily during heavy rains we could probably supply a large part of the nitrogen in this form. Or if it could be carefully supplied in several fractional doses throughout the season we

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have demonstrated that a good yield of excellent tobacco can be grown with no other source of nitrogen except nitrate. Such a practice, however, would require good judgment in timing the applications and an extra outlay of labor and at present it is perhaps fraught with too many risks to warrant general recommendation. So we fall back on our old empirical rule that not more than a fifth of the nitrogen be in the nitrate forms.

Among the various organic materials, 10 years of field tests have convinced the writer that most of the alleged differences in favor of this or that material over all others are largely imaginary. Large substitutions can be made between cottonseed meal, castor pomace, dry ground fish, linseed meal and some others that are not so well known. Variations in market prices offer a good opportunity here for economy.

Two nitrogenous materials which have come in for much discussion in recent years are urea and soybean oil meal.

Urea is chemically an organic material, but not a vegetable residue. It is very concentrated and compares favorably in price per pound of nitrogen with the mineral nitrates. It has some important advantages over the nitrates. In the first place it does not leach from the soil during heavy rains as the nitrates do. In the second place it builds up the available nitrogen in the soil after rains more rapidly than any of the vegetable or animal residue meals. These advantages coupled with its low price and economy of handling a concentrated material make it a desirable source of nitrogen. In field tests at the experiment station where it has been compared with other nitrogenous materials for the last 10 years it has given excellent yield and quality where various proportions up to 50 percent of the nitrogen was taken from urea. It is not advisable to derive all nitrogen from urea.

The most recent innovation in the nitrogen field is soybean oil meal, a material of about the same composition as cottonseed meal. It is a by-product of the soybean oil industry and in price should compete favorably with cottonseed meal. At the experiment station we have the results of only two years' tests. These have been unexpectedly favorable to the soybean product. The yield was not greatly different from that of the other meals, but the grading and quality in every test have been superior to all the other nitrogenous materials.

To supply the other essential elements there is not such a wide choice as there is in the nitrogen sources. Potash should come either from the high grade sulphate or from cottonhull ash.

Pure carbonate of potash is too expensive and is not so desirable as cottonhull ash. Muriate is excluded because of the chloride it contains. Tobacco stems is an excellent source of potash, but too expensive.

Magnesia is most cheaply supplied from magnesian limestone.

New Aspects of Fertilization

Condensed from American Fruit Grower

Dr. J. R. Magness

Pomologist, U. S. Department of Agriculture

IT is desirable to consider the fertilizer needs of the tree as distinct from the fertilizer needs of the sod or cover crop. The tree, for example, requires heavy intake of nitrogen during the early growing season. Equally heavy applications of nitrogen on the sod or cover crop are not necessary to secure good growth.

We have few, if any, clear-cut cases where trees have responded directly to applications of phosphorus, yet it is well known that cover and sod crops, particularly legumes, are heavy phosphorus users. Similarly, most of the orchard trees have not shown response to potash applications. We are much more likely to have favorable response to potash also in the more shallow-rooted crops.

Therefore, the problem, of fertilizing the tree is distinct and different from the problem of fertilizing the sod or cover crop that may be growing in the orchard.

As nearly as we are able to estimate from chemical analyses, a well-developed 20-year-old apple tree requires the intake of from three-fourth pound to one pound of actual nitrogen per year to maintain it in a good growing condition and to produce a good crop of fruit. About one-fourth to one-third pound of nitrogen is required for the development of a heavy fruit crop, one-third to one-half pound for the development of a good vigorous foliage system in the tree, and probably about one-fourth pound for the new wood, bark, and root tissues which are laid down each year. This amount of nitrogen would be carried in about five pounds of nitrate of soda or in about four pounds of sulphate of am-

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monia or cyanamid. These are the amounts that actually should go into the tree.

Unfortunately, we have no method of application of nitrogen fertilizer where all that is applied to the soil is taken up by the tree. Appreciable amounts of the nitrogen that are applied to the soil may be lost by leaching. Additional quantities are taken up by the sod or cover crop, particularly if the fertilizer is applied in the area where these crops are growing.

It is difficult to get nitrogen to the tree roots through a heavy grass sod. The grass roots form such a dense mat in the upper soil layers that the nitrogen is all absorbed there unless applications are excessively heavy. Consequently, considerably more than four to five pounds of nitrogen fertilizer must be supplied to insure one pound of actual nitrogen being taken into the tree.

While some nitrogen will be taken into the roots whenever it is present in available form, investigations now under way at the U. S. Horticultural Station, Beltsville, Md., indicate that nitrogen is taken up most rapidly and most actively when there is a foliage system on the tree. This can be readily understood if we picture the conditions of moisture and nitrogen intake that apply at different seasons of the year.

If readily available forms of nitrogen are applied in winter after the leaf system has fallen, this nitrogen goes into solution in the soil water and a part of it comes into contact with the roots. So far as we now know, that part which comes into contact with the roots is taken up by them and stored in the roots over winter.

When foliage is on the tree, a stream of water is continually passing from the soil to the roots up through the trees and evaporating from the leaves. Soluble nitrates in solution in the soil water would be carried to the roots by this water movement.

During the growing season there is rarely sufficient precipitation in many sections so that water is actually moving from the surface two or three feet of soil down into lower soil areas. Plant growth is continually drying the soil during the growing season, and summer rainfall is usually not more than enough to replace this water drawn out by the trees and other plants. Consequently, during the summer there is relatively little loss of nitrogen from leaching.

In the spring of 1937, nitrate of soda was applied to experimental trees at Beltsville growing in a gravelly, clay loam soil on March 25 and again on April 15. Between April 15 and 30, approximately five inches of rain fell. Analyses for nitrates in the soil taken after this rain showed

that much of the nitrate nitrogen, even when applied as late as April 15, had been carried below the main root zone, before the leaf system expanded and the period of rapid intake occurred. Analyses on these trees and growth response showed less nitrogen taken into the trees than where a similar application of nitrate was made to other trees after the foliage system had expanded.

While these rainfall conditions were somewhat unusual, the results indicate that if nitrate is put on very early in the spring and heavy rainfall occurs between that time and the bloom period, considerable nitrogen may be lost.

Thus, to secure maximum intake of nitrogen in the fall, it should be applied about a month or six weeks before leaf fall. In seasons of average rainfall, much of the nitrogen applied then should be taken into the tree before winter. For spring applications, the minimum loss of readily available forms of nitrogen will occur if application is delayed until near the period of full bloom. Delaying the spring application will also allow the grower to determine the fruit-bud set in his trees, and trees carrying a heavy bud set can be fertilized more heavily than those with few or no fruit buds.

If more slowly available forms of nitrogen are applied, such as cyanamid, the application must of necessity be earlier. Cyanamid must go through a number of changes before it becomes available for utilization by the trees. These changes require time. Also, if cyanamid is applied at the time or shortly before active growth is under way, it may prove directly injurious. Abundant available nitrogen is needed during the period of rapid growth lasting from the start of growth until about six weeks after bloom, and if the more slowly available forms of nitrogen are used, they should be applied early enough to be available for tree use by bloom time.

In order to secure the greatest economy in the use of nitrogen, it should be applied to those areas of the root zone where there is relatively little competition from the cover crop of sod. In most of our mature orchards there is relatively limited growth of sod under the spread of the tree branches. On the other hand, there is relatively dense development of apple roots throughout the whole area from the trunk out to the spread of the branches, the root population generally becoming less dense from the spread of the branches outward. Therefore, we would suggest that nitrogen be spread from the branch ends inward toward the trunk.

For trees 20 years old or more growing in sod, the minimum application should be one pound of actual nitrogen per tree. Even this application (six pounds of nitrate of soda or five pounds of sulphate of ammonia or cyanamid) probably is insufficient for maximum development of the tree, for some nitrogen will be lost. Unless this amount can be supplied, cultivation in the early spring to free nitrogen in the sod is advisable if the land is not too steep. Cultivation will reduce the nitrogen application required, but will not entirely replace the need for additional nitrogen in most orchards.

One point must be stressed in regard to feeding the tree. On most of our soils, the nitrogen that is taken into the tree largely determines the growth condition. Nitrogen applications must be larger than the theoretical tree requirement if the quantity needed for the tree is to be supplied.

Complete fertilizers, if used in feeding the tree, must carry this amount of nitrogen if satisfactory growth conditions are to result. If complete fertilizers are used, the total nitrogen in the fertilizer applied per tree should still be as large as indicated, if maximum growth and productiveness of the tree are to be obtained.

Under many orchard conditions it is not possible to get a good growth of sod or cover crop in the orchard without also feeding the cover crop. The maintenance of a good cover crop of sod is necessary (1) to prevent erosion and the loss of valuable surface soil which contains most of the nutrients (2) to maintain the organic matter which is the greatest reservoir of plant food in the soil, and (3) to insure penetration of water. On many soils, such sods or cover crops cannot be maintained without fertilization. This is particularly true where the orchards are old and where, in the early days of the orchard, much cultivation may have been done and considerable erosion occurred.

Where grass sods are being grown and these are not as dense and thrifty as they should be, application of complete fertilizer relatively high in nitrogen and phosphorus will unquestionably greatly improve the sod. Even 100 pounds per acre of such fertilizer broadcast over the soil area between the trees will greatly improve growth. With legume sods such as lespedezas, a fertilizer lower in nitrogen may be used, although even with these legumes the use of a fertilizer containing nitrogen will usually prove helpful in establishing them.

The West's Water Crop

Condensed from Farm Journal

J. H. Currie

THE one big crop which gives the biggest boost to farm income in the West is water. And the size of the water crop (which determines how much irrigation water each farm can have) depends on the amount of *snowfall.* Lots of snow, lots of irrigation water (and lots of floods, too); scant snowfall, less water for irrigation—that's about the way it works.

Western farmers are now getting the benefits of large scale snow surveys. Old as the theory of snow surveys is, it was only two years ago that the federal government and the various state agencies put the idea to work.

It was Dr. J. E. Church of the University of Nevada who pioneered and developed the present system of snow surveys. Perched on the summit of Mt. Rose, 10,800 feet above sea level in the Sierras, he developed the first instruments to measure accurately the depth of snow and tell the amount of water in the snow packs.

Others took up the work and in 1935 Congress authorized the Bureau of Agricultural Engineering of the U. S. Department of Agriculture to co-ordinate and standardize these snow surveys.

Once under way, the idea spread rapidly. Last winter an army of at least 1,500 men—forest rangers, national park service men, power company employees, trappers, etc.—trekked through the deep snows of eleven western states with measuring instruments.

Often the task called for superhuman effort and displays of heroism, for it required ski or snowshoe trips into rugged and uninhabited country and through all kinds of weather. It demanded seasoned, hardened woodsmen to withstand the rigors of these trips. One survey crew alone covered over 1,000 miles on skis last year to obtain snow samples.

Elaborate fall preparations are necessary to get ready for these snow surveys. Shelter cabins are built all along these winter courses to house the men. The cabins must be stout. Flimsy ones would crumple under the weight of from ten to twenty feet of snow. Many of them have elongated "Chimneys," down which the men must descend to reach

the cabins. These shelters are well provisioned and stocked with food, wood and blankets.

About 1,000 courses have been laid out to date, covering the major water sheds of the West. Snow courses are first carefully decided upon, then marked with large yellow signs, placed 15 to 25 feet above the ground on trees or poles so that they will not be buried under the deep snow. Snow measurements are taken only at these markers, so that the same spots will be used every year.

The instruments these men use to measure snow (made of aluminum) consist of a jointed hollow tube of small diameter calibrated in inches throughout its length, with an ice cutter on the end. This slender instrument is pushed down through the snow until it hits the ground. The tube with its inner core of snow is then weighed on a special scale that converts the snow weight into inches of water. Thus the surveyor records the depth of snow and the amount of actual water, for the amount of water varies greatly in different types of snow.

How accurate are the surveys? It is possible to predict within from 5% to 10% of the minimum supply of water that will be available for irrigation during the various months of the growing season. Thunder storms and summer rains will sometimes influence these estimates, but usually only to a limited extent.

This service has proven of inestimable value to power companies, city water supplies coming from mountain reservoirs, winter sports programs, and to farmers. In some areas, banks will not loan money on crops, nor will concerns such as sugar beet companies contract beets until water forecasts have been issued. If farmers can know in advance about potential water supplies, they can plan on this or that crop accordingly, not only as to the total area that would be planted, but also as to the division between early and late maturing crops.

The principal snow survey is usually made in April, as most of the snow has fallen by this time. Almost every state in the West has a designated central office where reports from snow surveyors in that area are received. Experts carefully compute these findings, immediately prepare a forecast, make it known by radio, newspapers and other means to waiting farmers. Ofttimes a May survey is made to determine how much of the snow has melted.

Sometimes severe weather conditions prevent surveyors from getting back to civilization to hand in their reports. Experiments are therefore being made this season in the use of short

wave radio to transmit these messages. In several instances these radios have been responsible for bringing help to injured or snowbound surveyors.

Snow surveys have progressed so far in the past few years and are now on such a well organized basis that some of the eastern states have shown interest in this work.

Australia, Canada, Newfoundland, and other countries have been watching the development of snow surveys in the United States with great interest and have recently established similar type surveys of their own. In 1936 representatives from all these countries met in Scotland and established an International Commission on the Hydrology of Snow and Ice to advance world-wide study on this subject.

A striking incident vividly portrays the great value of these snow surveys. In 1934, the April survey made by the Utah group showed that the potential water supply in their state did not exceed 35% of normal.

This alarming fact was immediately reported to the governor who, after consultation, called the first drought conference in history to be held before the drought occurred. Crops were curtailed and other measures taken to meet the situation. As a result Utah was fully prepared to cope with what proved to be one of the driest years on record.

What will the water crop be this summer? Over the radio in San Francisco recently, Paul Ewing, irrigation specialist of the Bureau of Agricultural Engineering, said:

"Water conditions are better than normal and there is a possibility that additional snows in late April may add even more to our present water storage.

"In the Rocky Mountains, north of the Rio Grande, the snow lies high and of good quality. In Utah, March storms greatly improved early prospects. The outlook in Washington is excellent. Some variation exists in Oregon. The Southwest (Nevada, Arizona and New Mexico) is a little short of snow. California's prospects are unusually good.

"Early spring storms in California's Sierra Mountains established the greatest snow pack in some sections since 1911. All over the West, reservoir storage is generally better than normal."

Predictions are that California's heavy snow pack may cause disastrous floods if high temperatures or warm rains suddenly melt mountain snow packs this summer. Said California's Governor Frank F. Merriam on March 29: "In June or July, California's two large interior valleys, the Sacramento and San Joaquin, may face the most serious flood situation in its history."

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